THURSDAY, OCTOBER 20, 1898.

PEARY'S "NORTHWARD OVER THE GREAT ICE."

Northward over the "Great Ice." A narrative of life and work along the shores and upon the interior ice-cap of Northern Greenland in the years 1886 *and* 1891–1897. *With a description of the little tribe of Smith Sound Eskimos, the most northerly human beings in the world, and an account of the discovery and bringing home of the "Saviksue" or great Cape York meteorites.* By Robert E. Peary, Civil Engineer, U.S.N. With Maps, Diagrams, and about eight hundred Illustrations. In two volumes. Pp. lxxx + 522 and xiv + 626. (London: Methuen and Co., 1898.)

IT may safely be said that the title-page is the dreariest in this book. It lacks the quaintness which enlivened the gossipy titles of the sixteenth century, and it does not altogether dispense with the necessity for a table of contents. The maps also are extremely disappointing, and it is to be regretted that the English edition at least was not provided with a well-executed map of part of the polar regions on a fair scale, especially as Mr. Peary repeatedly found errors in the existing charts which his observations enabled him to correct. The new work, however, has probably been postponed until the expedition on which Mr. Peary is now engaged—the survey of the Arctic archipelago, north of Greenland—has been carried out. We are promised a full discussion by specialists of the various branches of science studied by the members of the various expeditions, the record of which fills these volumes. They profess only to give a popular account of the work accomplished, and they do this in a full and satisfactory manner. The almost innumerable illustrations differ in quality, but many of them are remarkably clear and some have an artistic beauty that is unusual.

The outward form of the book is like that of most books of popular travel, but within there are marked differences. The amounts of time occupied and of space covered were so large that the narrative had to be compressed (to the detriment of the printing towards the end), in order to get it into two volumes. Hence, as the author states, there was no room for padding. An excellent device is that of following each section describing an expedition with a summary of the objects and results. One result not mentioned is that Mr. Peary has obtained more experience of long-distance sledge-travelling with dogs, and of life at extremely low temperatures, than any other living man.

With regard to these Arctic journeys it is desirable to point out that they are the work of one man, an enthusiast determined to persevere in the attempt to accomplish his plans, but absolutely unfettered by the instructions or advice of others. The United States Government have done no more for him than to renew his leave with increasing reluctance, the scientific societies have supported him, but could only give very small money grants, a few private friends have done something to help forward the expeditions; but in every case the greater part of the funds has been provided by the efforts of Mr. and Mrs. Peary themselves. All they have been able to make they have put into the equipment of the new expedition, and from a pecuniary point of view it is impossible that the labours of so many years of effort can meet with an adequate reward.

Mr. Peary is very frank in expressing his opinion about himself, he bases his passion for Arctic travel mainly on sentiment, but the sentiment bears fruit in sober plans, laborious scientific researches, and a terse manly narrative of occurrences.

The object of the first journey in 1886 was "to gain a practical knowledge of the obstacles and ice conditions of the interior of Greenland, to put to the test of actual use certain methods and details of equipment, to make such scientific observations as may be practicable, and to push into the interior as far as possible."

The results were the attainment of a greater distance inland and a higher elevation on the inland ice than had been previously done by any white man, and a great deal of valuable experience as to equipment and methods. Mr. Peary, on his return, drew attention to three lines along which the crossing of Greenland from west to east should be attempted, and he demonstrated that the attempt was practicable.

In 1888 Dr. Nansen succeeded in crossing the south of Greenland from east to west; and accordingly Peary concentrated his attention on the northern routes, although it was not until the summer of 1891 that he was able to escape from official routine and resume exploration.

The objects of the 1891–92 expedition were the determination of the northern limit of Greenland overland the possible discovery of the most practicable route to the pole, the study of the Smith Sound Eskimos, and the securing of geographical and meteorological data.

The results were highly satisfactory. The conditions of travel over the smooth elevated surface of the inland ice were worked out, one of the most interesting details being the use of an odometer or measuring wheel attached to a sledge, in order to give distances by dead reckoning; another was to demonstrate the possibility of sleeping at the lowest recorded temperatures in the open air without either tent or sleeping bag. The inland ice was found to have the same shield shape in the extreme north as Nansen showed it to have in the south, and the surface was smooth and unbroken, except near the edges and where the glacier basins dipped to the north. The insularity of Greenland was determined to Mr. Peary's satisfaction, grass was found growing, and musk-oxen feeding north of the ice-cap; and still further north, beyond a narrow strait, low land was discovered free from ice. In addition, comprehensive meteorological and tidal observations were made at the base station on Inglefield Gulf, the shores of which were surveyed, and the tribe of Arctic Highlanders were exhaustively studied and photographed as no tribe of Eskimos had been before.

The expedition of 1893-94 set out with an ambitious programme. A large party was to cross the ice-cap to Independence Bay on the north-east coast, and there to divide: part going north in an attempt on the pole, part turning south to trace the unknown east coast of Greenland. It was a failure. Mr. Peary points out that the efforts he was obliged to make to raise funds prevented

him from exercising sufficient care in selecting his companions. He broke one of his own rules by taking too many, and the majority of them turned out totally unfit for the work. The climatic conditions, too, were very unfavourable, a succession of furious gales was encountered with temperatures down to – 60° F., but before acknowledging defeat a magnificent effort was made to cross the ice-cap.

In 1894-95 Mr. Peary remained in Greenland, whilst his wife, their little daughter, and the majority of his party returned to the United States. One white companion, Lee, and the negro servant, Henson, alone remained faithful, and in the spring of 1895 Peary and Henson, provided with insufficient supplies, once more made the long tramp across the inland ice, rising to over 8000 feet, and back again, 1200 miles in all, reaching the base with one surviving dog and no food. The hardships were severe, and it was impossible to extend the observations at Independence Bay beyond those made in 1892, but the effort was heroic. A visit to Cape York before returning was rewarded by the discovery of the sources of native iron which Sir John Ross heard of in 1818. They were found to be three large meteorites, and the summer trips of 1896 and 1897 were successful in bringing them back (see NATURE, vol. lvii. p. 132.)

During these expeditions the knowledge of the Arctic regions had been greatly advanced by other explorers, and the drift of the *Fram* convinced Mr. Peary that the only reasonable chance of reaching the pole was from the north of Greenland. To this purpose he now intends to devote himself, and his plan is to become for the time practically an Eskimo, living in snow igloos, and accompanied by a few picked families of the Smith Sound tribe, every individual of which he has come to know well. Experiments during his three winters in the far north have convinced him that it is quite practicable in good weather to travel with sledges during the Arctic night, although of course the greater part of his journeys will be done in summer.

Apart from the direct work of the Peary expeditions, great scientific advantages have accrued from the summer parties he has taken up in successive years. These included Prof. Chamberlin of Chicago, Prof. Heilprin of Philadelphia, Prof. Tarr of New York, and a large number of other specialists; and already some important monographs, such as those of Prof. Chamberlin on Glacial Phenomena, have been published.

In meteorology there is one fact of great importance clearly demonstrated, which Nansen refers to as probably true in the account of his crossing of Greenland. It is that the wind always blows strongly outward from the interior. Once arrived at the summit level of the ice-cap, whether going east or west, Peary always found a strong favourable wind, enabling him to use sails on the sledges. The condensation of air by the extreme cold of the high plateau would naturally give rise to outflowing winds, and the question arises how far this area of permanent low temperature, producing a permanent anticyclonic condition at an altitude of from 5000 to 10,000 feet, may not be responsible for the existence of the low-pressure area south-east of Greenland, which exercises so large an influence on the climate of north-western Europe. The influence of the constant down-draught carrying air from high regions of the atmosphere to sea-level has probably not been hitherto sufficiently considered by meteorologists, and the observations in Greenland suggest what the condition of things on the Antarctic ice-sheet must be. Föhn effects of a very remarkable kind were observed by Peary giving rise on one occasion to deluges of rain, which were instantly afterwards converted into solid ice.

HUGH ROBERT MILL.

MODERN MYCOLOGICAL METHODS.

Mykologische Untersuchungen aus den Tropen (*Mycological Researches in the Tropics*). By Dr. Carl Holtermann. Pp. viii + 122, and Plates. (Berlin: Gebrüder Borntraeger, 1898.)

THE exceedingly important and original investigations prosecuted during a sojourn of fourteen months in Ceylon, Java, Borneo, and the Straits Settlements, by Dr. Holtermann, can only be compared with the admirable work done by Dr. Möller in Brazil, inasmuch as both authors adopted the Brefeldian method of research by means of pure cultures, and both paid special attention to the simpler forms belonging respectively to the Ascomycetes and the Basidiomycetes. Dr. Holtermann commences by creating a new genus belonging to the Hemiasci, and utilises it as a means of perpetuating for all time the full name of the talented author of "Unters. aus dem Gesamm. der Mykologie" by calling it *Oscarbrefeldia*.

Failing a terse generic diagnosis, the salient features of the genus cannot be ascertained morphologically. The species is *O. pellucida*, bearing remarkably large conidia. The asci are terminal or rarely intercalary, and at maturity contain four 1-septate spores. A second new genus appertaining to the Hemiasci is *Conidiascus*, which, like the preceding, occurs in "Schleimfluss" on trunks of trees in company with various Anguillideæ, Bacteria, Oidium, &c. The feature of this species is that the apparent asci are in reality conidia, the protoplasm of which becomes differentiated into spores; if a structure develops, the protoplasm of which remains unsegmented, it has been considered as a conidium; if the contents divide into several bodies, each capable of germination, it has been considered as an ascus containing spores; in the present species the two are considered as conidia exhibiting a difference of degree only as to division, or not, of the protoplasm. Coming to the Basidiomycetes, we find a new species of *Lentinus* described as *L. variabilis*. Under certain conditions of culture the germinating spores produced a fertile structure resembling the genus *Hypochnus*, considered as a very primitive type of the Basidiomycetes. Under a different set of conditions, spores of the same *Lentinus* gave origin to structures resembling *Clavaria*, a type much higher than *Hypochnus*. Hence the author says:—

"Hier liegt ein Fall vor, der sich mit einigem Recht zu phylogenetischen Speculationen verwenden lässt. Den der Pilz durchläuft Entwickelungsstadien, die selbständigen Formen in der freien Natur entsprechen. Das erste Stadium findet in *Hypochnus*, das andere in *Clavaria* fast einen Doppelgänger."

It has been known for a long time that species of *Lentinus*, when developing on wood in dark places, as

pits, cellars, &c., assumes very grotesque forms in which the pileus is suppressed, and the stems consequently more or less resemble species of *Clavaria*, but hitherto every one considered these productions simply as monstrosities due to an exceptional environment. Whether these antiquated views, or the later one propounded by Dr. Holtermann prove to be correct, we consider yet remains to be proved.

Polyporus polymorphous, as found in nature, resembles a bracket in form attached by one edge to the matrix, from which it projects at right angles. The spores of this species in cultures produce a thin crust attached by its entire under surface to the substratum, its upper surface being covered with pores bearing the hymenium, a *Poria* in fact. In this case again, systematists have long known that the higher forms included under *Polyporus*, *Fomes*, and *Polystictus*, not unfrequently develop the resupinate or *Poria* form, often showing every transition from one to the other; but this was included under the presumed elasticity of the species, as such forms are developed more especially when the fungus occurs in conditions different from those under which it appears in its normal or highest known stage of development. Every departure from the normal form of a species cannot surely be considered as a retrogression towards a phase lower in the evolution of the species, even if the exceptional development bears a resemblance to some genus lower in the scale of organisation, and through which phase the species under consideration may presumably be supposed to have passed. Pure cultures in various nutritive media grown on a slip of glass come under the category of things grown under conditions that may be termed as exceptional, to say the least, and the fact that such developments represent phases in the normal life-history of the species investigated, or indicate its phylogeny, has yet to be proved.

Another new genus is named *Van Romburghia*, the one species stands as *V. R. silvestris*.

In the introduction the author states that as his principal object is to elucidate the life-history of forms, he has not attempted pedantic diagnoses of forms. Having been sufficiently pedantic to establish five new genera, and above a score of new species, the amount of pedantry would not have been much accentuated by the addition of diagnoses of each of these. Apart from interpretations bearing on the cultures, every mycologist will welcome the work done by Dr. Holtermann, which is a model of exactness, and bears on its face the stamp of accuracy. The twelve plates add much to the value of the work.

G. Massee.

OUR BOOK SHELF.

Applied Magnetism: an Introduction to the Design of Electromagnetic Apparatus. By J. A. Kingdon, B.A. Pp. 292. (London: H. Alabaster, Gatehouse, and Co.)

Mr. Kingdon commences his book with the magnetic flux, and his readers are evidently expected to bring their equipment of dynamics, elementary information as to units and electrical phenomena, with them. Ohm's law is introduced apparently for the purpose of bringing in its magnetic equivalent, and the fact that the coincidence is rather one of form than substance ought, we think, to have been pointed out. Reluctance and permeability are defined and shortly treated, and tables of magnetic force, induction, and permeability are given for various kinds of iron. Then follow specimens of elementary calculations regarding magnetic circuits.

The next chapter is entitled Magneto-motive Force of Current. The magnetic fields of different simple arrangements of conductors are first discussed, thus the force at the centre of a circular coil is worked out, and the field intensity—Biot and Savart's result—for a straight current is calculated from the simple law of magnetic force due to an element of a current. This law, as a matter of fact, was derived by Laplace from Biot and Savart's result for a straight current, and the recovery of the experimental result is interesting only as showing how the inverse square of the distance law for an element leads to the law of the inverse distance for a long straight conductor. The exact directions of the magnetic forces produced by the currents in elements of conductors seem not to be always quite clearly given, and some amplification of this part of the book seems desirable. We may say that we do not like the name "mags" any more than we liked the names "hens" and "millihens," which were once proposed for other units. Abbreviations which have any flavour of extraneous association should not be tolerated.

We come next to Tractive Force of Magnets and Current Reactions, with the pereameter method of testing iron, and some results thereby obtained for Krupp steel and Lowmoor iron.

Next we have a rapid account of the Generation of Electromotive Force by variation of magnetic flux through a circuit, or across a moving conductor, and the idea of self-induction is introduced. What exactly the self-induction or self-inductance of a coil is does not seem to be defined, though several things have their definitions given which certainly do not more deserve attention.

Alternators and other forms of direct current generator are described, and specimens of various calculations given. But we have looked in vain for the characteristic curves by which Hopkinson did so much for the practical working out of the dynamo. Surely in a book the object of which is to deal with practical calculations regarding magnetic circuits, this matter of all others ought to have received attention. Yet it is not even mentioned!

The book will be found to give information of considerable service on many points, but it is not homogeneous and consistent enough in its treatment. The chances are about even that if it is consulted on some important point the matter will not be found treated. With some rewriting and additions its usefulness will be much increased.

Biomechanik erschlossen aus dem Principe der Organogenese. By Dr. E. Mehnert. Pp. viii + 177. (Jena: Fischer, 1898.)

At a time when "vitalism" is rife, and the disbelief in Natural Selection is almost a disease, an attempt to explain the phenomena of development on mechanical grounds is very welcome.

In this treatise Mehnert has examined very thoroughly the groundwork of organogeny, and has had little difficulty in showing, by reference to the development of such organs as the heart and blood-vessels, the pineal eye, the neurenteric canal, and so on, that the exceedingly loose interpretation commonly given to the law of recapitulation, namely that embryogeny is, *pure and simple*, a repetition of phylogeny, is absolutely incorrect; in fact, the ontogenetic is frequently the very reverse of the phylogenetic order—in all cases the order of development has become changed.

By a careful consideration of very numerous facts Mehnert shows that the principal factors in this alter-

ation have been on the one hand Abbreviation, or the early arrest of development, and Retardation, or the late appearance of the first signs of an organ, acting, together or separately, on regressive organs; while on the other hand Acceleration, or the early appearance and rapid development of an organ, and Prolongation, or gradual increase in the length of life, are influences to which progressive organs are subject.

These four factors then, separately or combined, condition ontogeny, and hence is formulated the "fundamental law of organogeny," that the rate of development of an organ is proportional to the degree, at the time, of its phyletic development; so that ontogeny is a very much modified recapitulation of phylogeny.

In the development of an individual it is therefore possible to discern two influences at work: (1) the hereditary, recapitulating, phylogenetic influence, and (2) functional epigenesis, due to the direct action of inner and outer causes, such as surrounding organs, food, temperature, gravity, and so on. Mehnert is, perhaps, not as clear as he might be, when he comes to deal with the exact way in which these environmental changes have become inherited; but (without mentioning Natural Selection) he seems to tend towards a Lamarckian inheritance of acquired characters. He discards, however, a chemical pangenesis, and explains the influence of the soma on the germ by a physical theory—analogous to magnetisation—which has at least the merit of being novel.

At the end of the book are some remarks on the specific variations in embryogeny, and in length of life, and on involution.

The epigenetic modifications of the phylogenetic order, perhaps the most valuable part of this work, are graphically illustrated by numerous diagrams.

Practical Plant Physiology. By Dr. W. Detmer. Translated from the second German edition by S. A. Moor, M.A. (Camb.), F.L.S. (London: Sonnenschein and Co., Ltd., 1898.)

A TRANSLATION of Detmer's "Pflanzenphysiologische Practicum" will doubtless be very acceptable to students of vegetable physiology in English-speaking countries. Since its publication Detmer's work has always been a standard one, and its second edition was in many ways a great improvement on the first. However, notwithstanding the high reputation of the German edition, it seems a pity that the translator should decide that "no sufficient reason has been found for addition or alteration"; for, with but little extra trouble, a very complete English text-book could have been made of the translation. By including physiological work published since 1895, and by the addition of more complete references to older researches, the usefulness of the book would have been largely increased.

The German edition has already been reviewed in a previous number of NATURE, so that little need be said of the translation. The translator's style is good, and he reproduces faithfully the sketchy and note-book-like form of the original. It may be added that the English edition is well printed, and the illustrations have hardly suffered in their reproduction. H. H. D.

A Chemical Laboratory Course. By A. F. Hogg, M.A., F.C.S. Pp. 24. (Darlington: James Dodds, 1898.)

A SERIES of experiments, arranged to illustrate elementary chemical analysis, are briefly described in this pamphlet. The experiments are arranged to accompany lectures on water, air, combustion, &c., and they form a course of work for the elementary and advanced stages of inorganic chemistry of the Department of Science and Art. Little information is given in addition to instructions for carrying out the experiments.

LETTERS TO THE EDITOR

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Stereo-chemistry and Vitalism.

BEFORE commenting on the argument for Vitalism urged in the opening address of Prof. Japp to the Chemical Section of the British Association, it will be best to quote from the report published in NATURE such passages as clearly present his position. He said:—

"Pasteur's point is, that whereas living nature can make a *single* optically active compound, these laboratory reactions, to which we resort in synthesising such compounds, always produce, simultaneously, at least *two*, of equal and opposite optical activity; the result being intermolecular compensation and consequent optical inactivity. . . .

"If these conclusions are correct, as I believe they are, then the *absolute origin* of the compounds of one-sided asymmetry to be found in the living world is a mystery as profound as the absolute origin of life itself. The two phenomena are intimately connected for, as we have seen, these symmetric [? asymmetric] compounds make their appearance with life, and are inseparable from it.

"How, for example, could lævo-rotatory protein (or whatever the first asymmetric compound may have been) be spontaneously generated in a world of symmetric matter and of forces which are either symmetric or, if asymmetric, are asymmetric in two opposite senses? What mechanism could account for such selective production? Or if, on the other hand, we suppose that dextro- and lævo-protein were simultaneously formed, what conditions of environment existing in such a world could account for the survival of the one form and the disappearance of the other?"

The last sentence implies the assumption that in the absence of some special unknown cause, the mixed right-handed and left-handed molecules which neutralise each other's optical activities would remain mixed. But is this a valid assumption? Is there not, contrariwise, a general cause for the separation of them? Prof. Japp appears to have taken no account of a universal law displayed throughout that continuous redistribution of matter and motion which constitutes Evolution. In the second part of "First Principles" will be found a chapter entitled "Segregation," in which this law and its results are set forth. After illustrations of the process of segregation as it everywhere goes on in astronomic changes, geologic changes, changes in organisms considered individually and as an aggregate, changes throughout mental evolution and social evolution, there come at the close of the chapter the following paragraphs:—

"The abstract propositions involved are these:—First, that like units, subject to a uniform force capable of producing motion in them, will be moved to like degrees in the same direction. Second, that like units if exposed to unlike forces capable of producing motion in them, will be differently moved—moved either in different directions or to different degrees in the same direction. Third, that unlike units if acted on by a uniform force capable of producing motion in them, will be differently moved—moved either in different directions or to different degrees in the same direction."

A subsequent paragraph argues that by resolution of forces it is demonstrable that any difference between the acting forces, or between the units on which they act, implies the presence of some force, active or reactive, in the one not present in the other; and that supposing the conditions are such as to permit motion, this differential force must, in virtue of the law of the persistence of force (conservation of energy) produce a differential motion. Hence the corollary is that—

"Any unlikeness in the incident forces, where the things acted on are alike, must generate a difference between the effects; since otherwise, the differential force produces no effect, and force is not persistent. Any unlikeness in the things acted on, where the incident forces are alike, must generate a difference between the effects; since otherwise, the differential force whereby these things are made unlike, produces no effect, and force is not persistent." [1]

[1] This passage was written in 1862 at a time when the nomenclature now current was not established. Hence the use of the word force instead of energy. I still, however, adhere to the use of the word persistence, for the

Now from this process of segregation it must have happened that when "dextro- and lævo-protein were simultaneously formed" the two kinds of molecules, differently related to environing actions (say ethereal undulations alike in nature and direction), separated themselves into groups of their respective kinds. It is true that in virtue of the small differences between the two classes of molecules, the minute differential actions of forces upon them might be long in producing their effects; and, further, that the segregation might be impeded by restraining forces. But when we remember that segregations take place in long periods of time even where the restraining forces are very great, as instance the formation of hematite nodules and flints in chalk-formations or of siliceous concretions in limestone, the implication is that the segregation would slowly, if not quickly, take place. And then the molecules of either group would exhibit just that optical activity which Prof. Japp, following Pasteur, alleges can result only from molecules formed by vital action.

I do not draw attention to this truth for the purpose of showing the adequacy of the physico-chemical interpretation of life, but for the purpose of showing the inadequacy of Prof. Japp's argument against it. My own belief is that neither interpretation is adequate. A recently-issued revised and enlarged edition of the first volume of the "Principles of Biology" contains a chapter on "The Dynamical Element in Life," in which I have contended that the theory of a vital principle fails and that the physico-chemical theory also fails: the corollary being that in its ultimate nature Life is incomprehensible.

Brighton, October 12. HERBERT SPENCER.

Organic Variations and their Interpretation.

I SHOULD like, if you will kindly afford me a little space, to offer a few remarks on Prof. Weldon's presidential address to Section D of the British Association.

The first part of that address deals with the question whether individual variations are fortuitous, *i.e.* occur by chance. It contains a very able and lucid exposition of the fact that the distribution of individual variations is of a similar kind, and is open to the same mathematical treatment, as events which happen by chance. I do not think that any one has denied this. It does not admit of dispute. But it is no answer whatever to the reasoning of those who oppose the theory of Natural Selection. The question is whether a given modification, the degrees of which are distributed among individuals according to what may be called the law of chance, originated accidentally, or as the result of a definite ascertainable cause. To give an illustration. If I plant a hundred or a thousand sunflower seeds in good soil in a market garden, at about equal distances from one another, I get a number of sunflower plants which will not all be of the same size. If I measure their heights, or take their weights, I shall find that these magnitudes are so distributed as to form one of Prof. Weldon's curves. If I take another hundred or thousand seeds from the same sack, and plant them in flower-pots, each 6 inches in diameter and of exactly the same capacity, placing the flower-pots in the same garden, I shall get a number of sunflower plants whose heights or weights will form a curve of the same kind. *But* the mean height or weight of the second lot of plants will be very much less than that of the first lot. This I know to be true because I have tried it. The distribution of the magnitudes has nothing whatever to do with the cause of the difference in the two cases. That cause is limited nourishment in the second case. Similarly in the progressive modification of animals and plants under natural conditions, the distribution among individuals of the degrees of a character has nothing whatever to do with the question of the cause of the character. When selection takes place, by breeding from the larger or the smaller variations, the mean of a character may be raised or lowered, but the question is whether this can be done without regard to conditions of life or not. In numbers of cases there is reason to believe that it cannot. And there is reason to believe that in numbers of cases the mean of a character can be raised or lowered by the application of definite conditions without any selective breeding at all. I will not attempt to prove this here; all I wish to point out is, that Prof. Weldon's argument does not touch the question.

reason that the word conservation is doubly inappropriate. Conservation connotes a conserver and an act of conserving—conceptions utterly at variance with the doctrine asserted; and it also implies that in the absence of a conserver and an act of conserving, the energy would disappear, which is also a conception utterly at variance with the doctrine asserted.

Still more serious objections must be made to Prof. Weldon's evidence concerning the actual operation of selection with regard to the frontal breadth of *Carcinus mænas*. I do not dispute his measurements, but his interpretation of them, which seems to me obviously and demonstrably unsound. He finds that the mean frontal breadth of the crabs at Plymouth was less in 1895 than in 1893, and less in 1898 than in 1895. I have always held that he courted failure by taking for investigation a character which is known to be undergoing progressive change in the individual during growth. We know that change in the proportions of a crab occur only at the ecdysis. It is, I think, certain that the number of ecdyses depend on age, not on size. Prof. Weldon himself remarks that the estimate of age by size is a dangerous proceeding. Yet for individual variations he compares crabs of the same size, not of the same age. Now the results he finds with regard to the diminution in frontal breadth in terms of total length would be exactly the same, if the growth of the crabs had been less in 1895 and 1898 than in 1893; in other words, if the crabs of the same size had been in these years, on the average older, had on the average passed through more moults; for the older crab has a relatively smaller frontal breadth. Now have I any reason for supposing that the crabs grew more rapidly in 1893, and do I suppose that the increased muddiness of the water in Plymouth Sound caused a diminution in the rate of growth? I do not suppose that mud had anything to do with it, but I have good reason for holding that crabs, like oysters, grow faster and larger when the water is warmer. Here is what Mr. Garstang wrote in 1894 concerning the summer of 1893: "Under the influence of the great heat the temperature of the Channel waters rose continuously, until in August it attained a point unprecedented for a quarter of a century; and it was of the highest interest to observe the effect of this high temperature, and of the prolonged calmness of the sea, upon the floating population of the neighbouring portion of the Channel. Numbers of semi-oceanic forms which rarely reach our shores arrived in remarkable profusion. In June the tow-nets were crowded with Salps, while towards the latter end of August they were almost choked by masses of living Radiolaria." The beginning of the year 1895, on the other hand, was exceedingly cold, and in the summer the water temperature was less than in 1893. It is not certain, as so few crabs were measured in 1898, whether their mean frontal breadth was really less than in 1895. But it is a fact that although last winter was unusually mild, the water temperature off Looe in May and June was lower than in the same months in 1895.

It is remarkable that Prof. Weldon found the change in female crabs was less than in males, and it is difficult to understand why the sexes should be affected in different degrees by an increase in the muddiness of the water. On the other hand, as the males in crabs generally are larger than the females, the former would necessarily be more affected in their growth by temperature.

Next as to the experiment which is adduced to show that the increase of sediment is the cause of the selective destruction of the crabs with greater frontal breadth. The survivors of crabs placed in water with china clay had narrower foreheads. But this merely means that they were on the average older, and the younger specimens were killed first, which is what might be expected. Prof. Weldon believes that the cause of death was the entrance of the sediment into the gill chamber, but it appears that the dead crabs had been in the muddy water, while the living were killed after removal. There is no evidence that the clay entered before death, and any dead crab which had been some time in muddy water constantly stirred would probably have mud on its gills.

Lastly there is the experiment of keeping crabs in bottles for a period including a single moult. At first the crabs with broader foreheads died, and in this case the death is attributed to the putridity of the water. In this case there was no sediment, and putrefaction in the water has the same effect as sediment, a fact perfectly in agreement with the view that under unfavourable conditions the younger die first, but inconsistent with the view that death is due to the greater filtering power of the branchial apparatus in the narrower-fronted crabs. The mean frontal breadth having been decreased by selective deaths before the moult, was found, after the moult, to be greater than that of crabs from the sea of the same size. This again is easily explained by increased growth. The crabs in the bottles were

in warmer water and better fed than those in the sea, and therefore on the average were younger after the moult than a number from the sea of the same size. In fact the diminution of frontal breadth depends not on the size of the crab, but on the number of moults it has passed through, while the size depends on the increase at each moult. A crab which has moulted seven times may be smaller than one which has only moulted five or six times.

Another case is on record which seems to me to afford an exact parallel to Prof. Weldon's. In Darwin's "Descent of Man" is quoted the evidence of a hunter who asserted that in a certain district male deer with a single unbranched antler were becoming gradually more numerous and taking the place of those with normal branched antlers. The district referred to was that of the Adirondack Hills in North America. As the witness in question had hunted deer for twenty-one years, Darwin considered his evidence important. J. D. Caton, however, who for many years made the Cervidæ his special study in Canada, particularly investigated this case. He satisfied himself that there was no truth whatever in the evidence above mentioned. *The spike-horn bucks seen and killed in the Adirondacks were all yearling bucks with their first antlers.* In all species of Cervus the horns which first grow are simple pointed unbranched spikes; and to prove the existence of spike-horned bucks as a variety, it would be necessary to show that when they cast their horns they developed simple spikes every year throughout life. No attempt was made to prove this, and Caton describes cases which he observed himself, in which spike-horned bucks of unusually large size, which might have been supposed to be full grown, developed branched horns in the following year.

A final objection to Prof. Weldon's argument may be mentioned. All the crabs on whose measurements he bases the conclusion that the relative frontal breadth of the species in Plymouth Sound has actually decreased within a few years, are small specimens 10 to 15 mm., or about half an inch in length of carapace. He makes no attempt to show that the decrease has occurred in adult crabs. The efficiency of filtration would necessarily depend on the absolute size of the filtering mechanism, not on the relative size, since the size of the particles of mud to be excluded remains the same. A crab therefore which survived in consequence of its narrow frontal region at the size of half an inch, would have no advantage when it was 2 or 3 inches long, as the frontal region would then be absolutely much greater. If the mud then kills the small crabs with a broad frontal region, it ought to kill all the adult crabs without exception.

A simple method of testing the soundness of Prof. Weldon's conclusion, with regard to the crabs in Plymouth Sound, would be to compare the mean frontal breadth of adult crabs from that locality, with that of others collected outside the Sound, *e.g.* at the mouth of the Yealm, where the water is pure, and at Saltash, where the water is much more turbid. If the sediment in the Sound is really decreasing the mean frontal breadth by a process of selection, that dimension must be greater in clean water, and less where there is still more sediment.

J. T. CUNNINGHAM.

Penzance, September 24.

I SHOULD like to be allowed to make a few remarks upon Prof. Weldon's address to the Zoological Section of the British Association; for it seems to me—very interesting as it is—that it is entirely outside the real question of the evolution of varieties and species of animals.

My contention is that *individual differences*—with which Prof. Weldon is solely concerned—*do not afford the materials for new varieties or species* (I would refer the reader to my paper on "Individual Variations," *Natural Science*, vol. vi. p. 385).

A systematist has to consider differences of "form" as well as, and indeed, he regards it as much more important than, "size" or "number." Prof. Weldon, however, refers only to *size* in crabs and recruits, and to *number* in pigs' glands and petals of the buttercup.

If I understand Darwin's theory of "The origin of species by *means* of natural selection," an individual has some slight variation or *new* feature, which is beneficial to it in the struggle for life among other organisms, more especially of the same kind—as a "large population" of the same sort is what Darwin and Dr. Wallace demand—then, such an individual may prove itself best fitted to survive and ultimately establish a new variety, the others dying out in the struggle.

But, for one or more crabs to have a frontal breadth a little less than that of others in a group of the same kind of crab is *no new feature*. It is only an "individual difference," such as *all* organisms are subject to.

"Number" and "size," to be included in varietal characters must be more pronounced than in the case with the crabs. The extreme lengths of the carapace are given as 10·1 and 14·9 millimetres—*i.e.* two-fifths and three-fifths of an inch; but between those killed by suffocation and the smaller survivors, the greatest difference lies between 816·17 and 787·36, these numbers being the highest "mean frontal breadths in terms of carapace length = 1000"; so that the difference is 28·81, not 3 per cent.

Upon such insignificant differences the life or death of the crabs is supposed to hang!

But the contention presumably is that the smaller crabs will form a new variety. Will any zoological systematist accept this?

But is it not obvious that if natural selection has been always constantly at work in this supposed way with individual differences among plants and animals, *some* varieties might be looked for among buttercups and *Carcinus mœnas?* Take *Ranunculus Ficaria*, which furnished Mr. Burkill with materials for like observations (NATURE, February 7, p. 359, 1895), the petals of which vary much more in number than do those of buttercups. If natural selection has been busy over this species for centuries, how is it that *R. Fic.* remains *R. Fic.* still? for it grows in all sorts of places, favourable and unfavourable. It would be easy to make curves for individual differences for the number of petals, stamens, size of leaves, tubercles, &c., but it would all be a waste of energy as far as advancing any illustrations of evolution. Individual differences come up every year, in spite of natural selection and all its imaginary doings. Moreover similar individual differences occur in the leaves all over one and the same tree and of every kind; what can natural selection do among them?

In fact, no one has ever yet shown that a new species has ever arisen out of individual differences "observed in the individuals of the same species inhabiting the same confined area" ("Origin of Species," 6th ed., p. 34).

The utmost that Prof. Weldon has shown is that, *under abnormal and dangerous circumstances*, which have killed off other kinds of marine animals from the Sound at Plymouth, crabs are dying out too; but that the larger ones (older?) are killed off a little faster, perhaps, than the smaller (Is the orifice to the gills a little larger, so as to allow an easier passage for the mud?). We may compare this with the London fogs in winter, which raise the death-rate of older members of the community.

Prof. Weldon says: "I will show you that in those crabs small changes in size of the frontal breadth do, under certain circumstances, affect the death-rate."

As this is the very kernel of the whole matter—for he quotes Darwin as saying, "the theory asserts the smallest observable variation" (observe Darwin requires a "variation"; but there is *none* at all in any of Prof. Weldon's four examples) "may affect an animal's chance of survival," one anxiously looked out, on reading the address through, for the fulfilment of this promise; but near the end, all he says is, that the immediate cause of death was suffocation by mud clogging the gills, and adds: "I think it can be shown that a narrow frontal breadth renders one part of the process of filtration of water more efficient than it is in crabs of greater frontal breadth."

This opinion is unfortunately no scientific proof; and it is much to be regretted that he did not give us the grounds for his so thinking.

He only measured the carapaces and frontal breadths, but it is presumable that the legs were proportionally longer in the deceased crabs. The question therefore arises, were they, too, concerned in causing the increased death-rate of those with the bigger carapaces?

Once more, what has all this got to do with evolution? No one will dispute these interesting illustrations of chance—a name for all cases where one cannot trace actual causes, or inductive evidence—and its application to individual differences; which, by the way, Dr. Wallace now regards as "non-specific or developmental characters" (*Fortnightly Review*, March 1895, p. 444), and *not* leading to new varieties; as he did in his work on "Natural Selection" in 1871.

Natural selection determines what shall survive and what shall die in the universal struggle for life; but it has yet to be shown, that the origin of species has anything to do with it.

Prof. Weldon concludes with the observation that "numerical knowledge of this kind is the only ultimate test of the theory of natural selection; or of any other theory of any natural process whatever."

It has tested natural selection, and shown that nothing of the nature of a *true variety* has been established by it. There is no *evolution* in the process described at all.

Does he not speak a little too confidently as to there being no other means of investigation into the procedure of evolution?

The true method of establishing this doctrine, as in all other matters of science, I take to be by *inductive evidence* and *experimental verification*. By these it has been proved that true varietal changes are produced by what Darwin called "the definite action of changed conditions of life," and he added that when this was the case "a new sub-variety would be produced without the aid of natural selection" ("Animals and Plants under Domestication," vol. ii. pp. 271, 272).

In support of this contention of Darwin's I shall be happy to supply Prof. Weldon with an abundance of facts collected in my book, "The Origin of Plant Structures," if he will promise to read it, entirely unbiassed by his established belief in the efficacy of natural selection. GEORGE HENSLOW.

80 Holland Park, W.

THE points raised by Mr. Cunningham are numerous, and I trust that he will not think me wanting in courtesy if I make my answer to each of them as short as possible.

(1) I am glad Mr. Cunningham now believes that the fortuitous character of animal variation is in many cases indisputable, so that he no longer holds the view of chance adopted by Eimer and others (*cf.* Eimer, "Organic Evolution," translated by J. T. Cunningham. Macmillan, 1890).

(2) I cannot agree that the question, which the theory of natural selection attempts to answer, is the question "whether a given modification . . . originated accidentally, or as the result of a definite ascertainable cause." Without discussing the conception of an "accident" implied in this phase, I fail to see that the theory of natural selection involves a theory of the origin of variation: all it asserts is that the variation which is known to occur does affect the death-rate.

(3) The well-known fact, that a change in surrounding conditions often produces a change in the character of a race by methods other than that of selective destruction, does not disprove the co-existence of selective destruction. For example, Mr. Cunningham has not shown that the adaptation of sunflowers to life in six-inch flower-pots is effected without selective destruction; he has only shown that a portion of the change, associated with life in pots is effected without such destruction. By dividing a sample of seed of known origin into two portions, sowing seeds of one portion in a market garden, seeds of the other portion singly in a series of flower-pots, Mr. Cunningham has produced two different series of sunflowers, which differ in stature and in other characters. I fully accept Mr. Cunningham's statement that the plants in the flower-pots were modified without selective destruction. But these plants were not all alike; and unless it can be shown that each of them produced an equal number of seeds, of equal germinating power, so that if life in flower-pots had been continued each plant, whatever its stature, would have contributed an equal number of equally fertile offspring to the next generation,—unless this can be shown, the action of natural selection is by no means disproved. If among the sunflowers of different stature growing in similar flower-pots, plants of one stature produced more seed than plants of different stature, the plants of that stature were better "adapted" to life in flower-pots than the others, and in a struggle to occupy a world filled with six-inch flower-pots, the offspring of the more fertile plants would very probably win; so that a process of natural selection would occur. So far as Mr. Cunningham has described his observations, they do not exclude the possibility that this and other kinds of selection operate. All I am anxious to know, in those cases of organic evolution which I try to understand, is how much of the observed change is due to a process of selective destruction, how much to other causes.

(4) I heartily agree with the view that it is not possible for selection, under fixed conditions, to modify a species in every direction. It is only possible for natural selection to act so as to produce a race with a minimum death-rate. For example, since muddy water of a certain salinity kills broad-fronted crabs more quickly than narrow-fronted crabs, it is probably impossible for natural selection to increase the frontal breadth of crabs which live in such water.

(5) In the second part of his letter, Mr. Cunningham attempts an explanation of the evolution observed in Plymouth crabs, which does not involve any selective destruction. For this purpose he makes two hypotheses, one about the growth of crabs, one about the temperature of the sea-shore at Plymouth. Neither of these hypotheses seems to me to fit the facts. If I understand the hypothesis about growth, it is this: that the frontal breadth of a crab depends on its age, while the length of a crab depends not only upon age, but upon temperature and other circumstances affecting it during growth. From this it is deduced that in a group of crabs of the same length, those with narrower fronts are older, those with broader fronts are younger, and I suppose that those with equal fronts are assumed to be of the same age. Therefore, when I say that under certain conditions the crabs with the broadest fronts die first, Mr. Cunningham assumes that under those conditions the youngest crabs die first. I do not know of any published account of the growth of crabs which supports this hypothesis, and the following facts seem to disprove it:—If we take a group of crabs, of the same length and the same frontal breadth, they are, on this view, nearly of an age: if we keep these crabs till they moult, they will grow at different rates during the moult; now those which increase abnormally much in length during the moult, will be younger than average crabs of their new length; those which show abnormally little increase in length, will be older than the majority of crabs of their new length. Mr. Cunningham says that in crabs of a given length, the youngest are the broadest; therefore those crabs which grew abnormally much ought to have broader fronts than their fellows of their new length, those crabs which grew abnormally little ought to be narrower than their fellows. I have worked out the relation between growth-rate and frontal breadth abnormality in more than 500 cases, and the relation which ought to hold, if Mr. Cunningham's hypothesis were true, does not hold.

A further disproof of the contention that the youngest crabs died first in my experiments is this: in most of the experiments about equal numbers of crabs of all lengths from 10 to 15 mm. were treated together; and all crabs used in an experiment were gathered on one day. It will hardly be contended that irregularity of growth goes so far as to produce in the same season crabs between 10 and 11 mm. long which are of the same age as crabs between 14 and 15 mm long. If the younger crabs died first in my experiments, a mortality of 70 or 80 per cent. might be expected to kill all, or nearly all the shorter crabs, the survivors being derived almost entirely from the longer crabs. This was not the case. For example, in one experiment 200 crabs, between 10 and 15 mm. long, were treated with mud until only four were left alive. These four were respectively 10·67 mm., 11·67 mm., 11·43 mm., and 12·11 mm. long.

(6) Mr. Cunningham further supposes, and no doubt rightly, that crabs grow faster, within certain limits, the warmer the water in which they are; so that crabs 10 mm. long, grown in warm water, are probably younger than crabs 10 mm. long grown in colder water. From observations made on the temperature of the Channel water, he thinks it probable that the crabs measured in 1893 were on the whole younger than those measured in 1895, and those measured this year were oldest of all,—all the crabs being of the same length. The reason for this is that the water in the Channel was exceptionally hot in 1893, and for some time exceptionally cool this year. But the stony beach where these crabs were collected looks due south, and is uncovered for hours daily, when it is often exposed to the direct rays of the sun. I am most unwilling to believe that the temperature on such a beach was lower during the past summer than in 1893. A further point is that crabs gathered in January ought, if Mr. Cunningham's hypothesis were true, to be distinctly narrower than crabs of the same length gathered in August. Crabs gathered last January were narrower than crabs gathered in August 1893, but they were not narrower than crabs gathered last August. So that all Mr. Cunningham's ingenious hypotheses fail to fit the facts.

(7) Mr. Cunningham says that there is no evidence of the entrance of fine mud into the gill-chambers of crabs during life. If he will watch a crab breathing in muddy water, or if he will consult the works of Mr. Garstang and other students of the subject, he will see that he is mistaken. I thought the entrance of such particles into the gill-chamber so well known that I need

not describe experiments (of which I have made plenty) in proof of its occurrence.

(8) I quite agree with Mr. Cunningham and Mr. Henslow, that it is my duty to describe the effect I believe fine mud to have upon the respiratory apparatus, and I am preparing such a description as quickly as I can. I hope also to be able before long to answer Mr. Cunningham's last and very pertinent question, whether crabs of given length, from the clear water outside Plymouth Sound, are broader or narrower than crabs of the same length from muddy waters within the Sound.

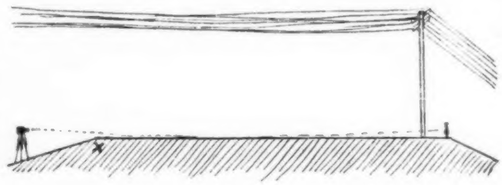
(9) I altogether fail to understand Mr. Henslow's letter, and I fear that my imperfect exposition has led him to misunderstand me as completely as he has misunderstood one of the clearest passages in the "Origin of Species." Mr. Henslow suggests that a variation, fit to afford material for natural selection, must be a *new* character, differing in some mysterious and undefined way from those individual differences which he refuses to call variations; and he further attributes the same view to Mr. Darwin. If Mr. Henslow will read once more the section of the fourth chapter of the "Origin of Species" headed "Illustrations of the Action of Natural Selection, &c.," he will see that Mr. Darwin does not express this opinion. The important thing to determine is not what any man, however eminent, has said about the importance of differences between individual animals, but what that importance can be shown to be. The crabs at Plymouth have not, during the past five years, exhibited any changes in the magnitude of their frontal breadth which Mr. Henslow would rank as a variation, but they have exhibited individual differences. During these five years the mean frontal breadth ratio has changed nearly 2 per cent., so that the change now going on would produce, if it were to continue at the same rate for fifty years, a change big enough to constitute a difference which most men would rank as specific. I have endeavoured to show that this change has been accompanied by a destruction which has acted selectively upon individual differences. Mr. Henslow has not seriously discussed this attempt of mine, but ridicules the idea that so small a change can be of importance in relation to evolution. If the mean stature of Englishmen were to diminish by an inch in a few years, I presume Mr. Henslow would regard such change as rapid and important; but the percentage change would be less than that which Mr. Thompson and I have demonstrated during the past five years in crabs.

W. F. R. WELDON.

Mirage on City Pavements.

DURING my summer visits to San Francisco, I have been so frequently struck with the beautiful miniature mirages that can be seen on the flagstone sidewalks whenever the sun shines, that I determined to secure, if possible, a photograph of the phenomenon on a scale suitable for reproduction. One or two previous attempts in past years having been partial failures owing to the smallness of the image, I secured, through the kindness of a friend, the use of a very fine tele-objective capable of giving an image six or eight times as large as an ordinary objective of 12 inches focus. The streets over some of the hills are so laid out that it is possible, on nearing the brow, to bring the eye on the level of the side-walk, and look along a perfectly level stretch of one hundred yards or more. Standing in this position it is almost impossible to resist the conviction that the walk is flooded with a perfectly smooth sheet of water, in which the reflections of pedestrians can be seen as distinctly as in a mirror.

In order to observe the phenomenon it is necessary that a considerable stretch of level pavement be foreshortened into a very narrow strip. This is the condition in the photograph: the camera stood just below the brow of the hill, and the distance in the photograph from the X to where the children and the toy cart are standing, is an entire block (135 yards). The position of the camera and section of the hill-top are shown in the diagram. The apparent reflections, due to the



bending upward of the rays by the thin layer of heated air, come out very clearly in the picture, but the camera fails to give a correct reproduction of the extreme brilliancy of the reflecting layer of air.

On taking a few steps up the hill, decreasing the foreshortening, the glaze vanishes, and we see only the dull grey of the flagstones. Extremely hot sunshine is not necessary. I have observed the phenomenon early in the morning after a cold night, before the sun had reached the pavement, the slight warmth from the ground being sufficient. Under these conditions, however, the pavement must be more foreshortened than when in the full sunshine. The refracting layer is probably only a thin skin of warm air, which adheres as it were to the surface of the flagstones, for the mirage is unaffected by the strong winds which frequently sweep the top of the hill.

Probably these mirages can be seen on any level pavement where the eye can be brought into the proper position.

Physical Department of the University, R. W. WOOD.
Madison, Wisconsin, September 20.

Transference of Heat in Cooled Metal.

MY attention has just been called to two communications to your journal, entitled "Transference of Heat in Cooled Metal." The first, by M. Henry Bourget, appears in the issue of June 30, and the second, by Mr. Albert T. Bartlett, in the issue of September 1.

About the year 1880 I had occasion to heat one end of an iron bar to a bright red heat whilst holding the cooler end in my hand. Upon plunging the heated end into a bucket of water the cooler end became suddenly so hot that I was obliged to release my hold on it.

This phenomenon interested me very much, as I could find no explanation for the apparent reflection of heat to the cooler end of the bar; and in 1888, whilst working in the physical laboratory at Johns Hopkins University, I further investigated the matter.

To one end of an iron or steel bar was soldered a thermo-electric couple, the circuit of which was closed through a very sensitive, high resistance, Rowland, reflecting, galvanometer. The bar was passed through two pasteboard screens, and was supported in a horizontal position, the screens serving to intercept any heat which might be conveyed by radiation or convection through the air from one end of the bar to the other. Under the end of the bar, remote from that to which the thermo-electric couple was soldered, was placed a compound bunsen burner, by which the end of the bar was raised to a dull red heat. The spot of light on the galvanometric scale

moved off to the right very gradually as the cooler end of the bar became heated, but was brought back to a convenient point on the scale by means of a controlling magnet. When the state of steady flow was reached, the bunsen flame was removed, and water was immediately poured over the heated end of the bar. The spot of light on the galvanometer scale immediately moved off to the right, indicating an immediate rise of temperature at the cooler end of the bar.

The rapidity of the action was a second source of surprise to me, as it far exceeded the velocity of propagation of heat along the bar by conduction. I was obliged to discontinue this line of work for a time, and did not return to it till 1895, when I repeated the experiments described above, this time, however, using brass rods of various dimensions. In the case of the brass rods I failed to observe the same phenomenon, and concluded that the effect was due, as I had supposed in 1888, to much the same cause as recalescence.

I should judge from my results that if the effect exists at all in brass, it is yet much more pronounced in iron or steel.

At the time I made my experiments at Johns Hopkins University, I drew the attention of Prof. Henry A. Rowland and Dr. Louis Duncan to the matter, the latter witnessing the experiments, and later I discussed it with Prof. Ogden N. Rood, of Columbia University, New York City. Prof. Rowland pointed out that theoretically there should be a very slight instantaneous effect, but that it should be a reduction and not an increase of temperature.

That the effect just described is altogether unaccounted for by the present mathematical theory of the propagation of heat in conductors is not very surprising in view of the fact that that theory postulates the constancy of the specific heat and thermal conductivity of the medium, whereas at high temperatures these properties vary considerably with the temperature, and particularly in the case of iron, the physical state undergoes a complete change of what Hopkinson termed the *critical temperature*, which varies in different specimens from 690° C. to 870° C.

In attempting an explanation of the phenomenon which we have been discussing, it seems to me fair to assume that the heat producing the sudden rise of temperature observed, is not transmitted along the rod with the great velocity observed in the tests, but that it exists at the cooler end of the rod before the rise of temperature occurs. When iron or steel which has been heated to redness is suddenly plunged into water a marked change takes place in the properties of the metal, and if this change of character in the metal is in part transmitted from particle to particle to the other end of the rod, and results in a lowering of the heat capacity of the material, a rise of temperature will result as observed. JOHN STONE STONE.

20 Newbury Street, Boston, Mass., U.S.A., September 19.

Animals and Poisonous Plants.

FROM repeated observations in my own garden, I know that song-thrushes will eat ripe mezereon berries greedily. In the winter of 1896 they cleared a small bush containing, perhaps, two hundred berries, in the course of a week or two, returning at once when driven away, and becoming half-stupefied; so that they might, apparently, have been caught with the hand.

Dr. Withering states ("British Plants," ed. 1812) that six berries of this shrub (*Daphne mezereum*) will kill a wolf.

According to the same authority, *Cicuta virosa* is a certain poison to cows; while goats devour it eagerly, and it is not injurious to sheep and horses. As to *Atropa belladonna*, a case which received much attention at the time may be found in the daily papers of some twenty years ago. A family were poisoned by eating rabbit-pie, the symptoms being those of atropine poisoning; and the inquiry, which followed, showed that rabbits do often eat deadly nightshade berries. J. C.

Loughton, Essex.

WITH reference to Mr. Bennett's inquiry as to the consumption of poisonous berries by birds, I remember a young blackbird, some years back, who used to frequent the garden of the house in which I was staying, and who eagerly swallowed the berries of the *Daphne mezereum*. He was rather tame and would take them when I threw them to him, following them as they rolled along the ground, as a chicken would go after peas. I see that Sowerby confirms the ordinary opinion as to the poisonous nature of these berries: "The whole plant is a powerful irritant, both bark, leaves and *fruit* acting poisonously if taken in large quantities. *A few of the berries have been known to cause death when swallowed.*" The blackbird did not seem the worse for them. EDWARD M. LANGLEY.

16 Adelaide Square, Bedford, October 15.

An Osteometric Index-Calculator.

I SHOULD feel obliged if any of your readers could inform me whether there is in use among anthropologists any mechanical appliance by which indices can be determined without loss of time and the possible inaccuracy attending an arithmetical calculation.

I am anxious to obtain information on this subject in order to find out if there is any simpler or possibly better instrument than one I have constructed. It consists of a graduated quadrant and a movable arm, and it is very helpful in doing the purely arithmetic work, as it shows accurately, at a glance, the index required from any two figures, and does not work by logarithms, as does the slide rule of engineers, which might be used for the purpose. DAVID WATERSTON.

Anatomical Department, University of Edinburgh, October 11.

Capture of Curious Crustaceans.

TWO living specimens of that very curious Crustacean *Stenorynchus phalangium* were taken in a net, off this coast, yesterday. E. L. J. RIDSDALE.

The Dene, Rottingdean, October 14.

A SHORT HISTORY OF SCIENTIFIC INSTRUCTION.[1]

II.

I MUST come back from this excursion to call your attention to the year 1845, in which one of the germs of our College first saw the light.

What was the condition of England in 1845? Her universities had degenerated into *hauts lycées*. With regard to the University teaching, I may state that even as late as the late fifties a senior wrangler—I had the story from himself—came to London from Cambridge expressly to walk about the streets to study crystals, prisms, and the like in the optician's windows. Of laboratories in the universities there were none; of science teaching in the schools there was none; there was no organisation for training science teachers.

If an artisan wished to improve his knowledge he had only the moribund Mechanics' Institutes to fall back upon.

The nation which then was renowned for its utilisation of waste material products allowed its mental products to remain undeveloped.

There was no Minister of Instruction, no councillors with a knowledge of the national scientific needs, no organised secondary or primary instruction. We lacked then everything that Germany had equipped herself with in the matter of scientific industries.

Did this matter? Was it more than a mere abstract question of a want of perfection?

It mattered very much! From all quarters came the cry that the national industries were being undermined in consequence of the more complete application of scientific methods to those of other countries.

The chemical industries were the first to feel this, and because England was then the seat of most of the large chemical works.[1]

Very few chemists were employed in these chemical works. There were in cases some so-called chemists at about bricklayers' wages—not much of an inducement to study chemistry; even if there had been practical laboratories, where it could have been properly learnt. Hence when efficient men were wanted they were got from

[1] An address delivered at the Royal College of Science by Sir Norman Lockyer, K.C.B., F.R.S., on October 6. (Continued from page 575.)

[1] Perkin, NATURE, xxxii. 334.

abroad—*i.e.* from Germany, or the richer English had to go abroad themselves.

At this time we had, fortunately for us, in England, in very high place, a German fully educated by all that could be learned at one of the best equipped modern German Universities, where he studied both science and the fine arts. I refer to the Prince Consort. From that year to his death he was the fountain of our English educational renaissance, drawing to himself men like Playfair, Clark and De la Beche; knowing what we lacked, he threw himself into the breach. This College is one of the many things the nation owes to him. His service to his adopted country, and the value of the institutions he helped to inaugurate, are by no means even yet fully recognised, because those from whom national recognition full and ample should have come, were, and to a great extent still are, the products of the old system of middle age scholasticism which his clear vision recognised was incapable by itself of coping with the conditions of modern civilised communities.

It was in the year 1845 that the influence of the Prince Consort began to be felt. Those who know most of the conditions of Science and Art then and now, know best how beneficial that influence was in both directions; my present purpose, however, has only reference to Science.

The College of Chemistry was founded in 1845, first as a private institution; the School of Mines was established by the Government in 1851.

In the next year, in the speech from the Throne at the opening of Parliament, Her Majesty spoke as follows:—"The advancement of the Fine Arts and of practical Science will be readily recognised by you as worthy the attention of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you having in view the promotion of these objects, towards which I invite your aid and co-operation."

Strange words these from the lips of an English sovereign!

The Government of this country was made at last to recognise the great factors of a peaceful nation's prosperity, and to reverse a policy which has been as disastrous to us as if they had insisted upon our naval needs being supplied by local effort as they were in Queen Elizabeth's time.

England has practically lost a century; one need not be a prophet to foresee that in another century's time our education and our scientific establishments will be as strongly organised by the British Government as the navy itself.

As a part of the comprehensive scheme referred to by Her Majesty, the Department of Science and Art was organised in 1853, and in the amalgamation of the College of Chemistry and the School of Mines we have the germ of our present institution.

But this was not the only science school founded by the Government. The Royal School of Naval Architecture and Marine Engineering was established by the Department at the request of the Lords Commissioners of the Admiralty "with a view of providing especially for the education of shipbuilding officers for Her Majesty's Service, and promoting the general study of the Science of Ship Building and Naval Engineering." It was not limited to persons in the Queen's Service, and it was opened on November 1, 1864. The present Royal College of Science was built for it and the College of Chemistry. In 1873 the School was transferred to the Royal Naval College, Greenwich, and this accident enabled the teaching from Jermyn Street to be transferred and proper practical instruction to be given at South Kensington. The Lords of the Admiralty expressed their entire satisfaction with the manner in which the instruction had been carried on at South Kensington; and well they might, for in a memorandum submitted to the Lord President in 1887, the President and Council of the Institute of Naval Architects state:—"When the Department dealt with the highest class of education in Naval Architecture by assisting in founding and by carrying on the School of Naval Architecture at South Kensington, the success which attended their efforts was phenomenal, the great majority of the rising men in the profession having been educated at that Institution."

Here I again point out, both with regard to the School of Mines, the School of Naval Architecture, and the later Normal School, that it was stern need that was in question, as in Egypt in old times.

Of the early history of the College I need say nothing after the addresses of my colleagues, Profs. Judd and Roberts-Austen, but I am anxious to refer to some parts of its present organisation and their effect on our national educational growth in some directions.

It was after 1870 that our institution gradually began to take its place as a Normal School—that is, that the teaching of teachers formed an important part of its organisation, because in that year the newly-established Departments having found that the great national want then was teachers of Science, began to take steps to secure them. Examinations had been inaugurated in 1859, but they were for outsiders, conferring certificates and a money reward on the most competent teachers tested in this way. These examinations were really controlled by our School, for Tyndall, Hofmann, Ramsay, Huxley, and Warington Smyth, the first professors, were also the first examiners.

Very interesting is it to look back at that first year's work, the first cast of the new educational net. After what I have said about the condition of Chemistry and the establishment of the College of Chemistry in 1845, you will not be surprised to hear that Dr. Hofmann was the most favoured—he had forty-four students.

Prof. Huxley found one student to tackle his questions, and he failed.

Profs. Ramsay and Warington Smyth had three each, but the two threes only made five; for both lists were headed by the name of

Judd, John W.,
Wesleyan Training College,
Westminster.

Our present Dean was caught in the first haul.

These examinations were continued till 1866, and upwards of 600 teachers obtained certificates, some of them in several subjects.

Having secured the teachers, the next thing the Department did was to utilise them. This was done in 1859 by the establishment of the Science Classes throughout the country which are, I think, the only part of our educational system which even the Germans envy us. The teaching might go on in schools, attics or cellars, there was neither age-limit nor distinction of sex or creed.

Let me insist upon the fact that from the outset practical work was encouraged by payments for apparatus, and that latterly the examinations themselves, in some of the subjects, have been practical.

The number of students under instruction in Science Classes under the department in the first year in which these classes were held, was 442; the number in 1897 was 202,496. The number of candidates examined in the first year in which local examinations were held, was 650, who worked 1000 papers; in 1897 the number was 106,185, who worked 159,724 papers, chemistry alone sending in 28,891 papers, mathematics 24,764, and physiography 16,879.

The total number of individual students under instruction in Science Classes under the Department from 1859 to 1897 inclusive has been, approximately, 2,000,000. Of these about 900,000 came forward for examination, the total number of papers worked by them being 3,195,170.

Now why have I brought these statistics before you?

Because from 1861 onwards the chief rewards of the successful students have been scholarships and exhibitions held in this College; a system adopted in the hope that in this way the numbers of perfectly trained Science Teachers might be increased, so that the Science Classes throughout the country might go on from strength to strength.

The Royal Exhibitions date from 1863, the National Scholars from 1884. The Free Studentships were added later.

The strict connection between the Science Classes throughout the country and our College will be gathered from the following statement, which refers to the present time:—

Twenty-one Royal Exhibitions — seven open each year—four to the Royal College of Science, London, and three to the Royal College of Science, Dublin.

Sixty-six National Scholarships — twenty-two open each year—tenable, at the option of the holder, at either the Royal College of Science, London, or the Royal College of Science, Dublin.

Eighteen Free Studentships—six open each year—to the Royal College of Science, London.

A Royal Exhibition entitles the holder to free admission to lectures and laboratories, and to instruction during the course for the Associateship—about three years—in the Royal College of Science, London, or the Royal College of Science, Dublin, with maintenance and travelling allowances.

A National Scholarship entitles the holder to free admission to lectures and laboratories and to instruction during the course of the Associateship—about three years —at either the Royal College of Science, London, or the Royal College of Science, Dublin, at the option of the holder, with maintenance and travelling allowances.

A Free Studentship entitles the holder to free admission to the lectures and laboratories and to instruction during the course for the Associateship—about three years—in the Royal College of Science, London, but not to any maintenance or travelling allowance.

Besides the above students who have been successful in the examinations of the Science Classes, a limited number (usually about 60) of teachers, and of students in science classes who intend to become science teachers, are admitted free for a term or session to the courses of instruction. They may be called upon to pass an entrance examination. Of these, there are two categories—those who come to learn and those who remain to teach; some of the latter may be associates.

Besides all these, those holding Whitworth Scholarships —the award of which is decided by the Science examinations—can, and some do, spend the year covered by the exhibition at the College.

In this way, then, is the École Normale side of our institution built up.

The number of Government students in the College in 1872 was 25; in 1886 it was 113, and in 1897 it was 186.

The total number of students who passed through the College from 1882–3 to 1896–97 inclusive was 4145. Of these 1966 were Government students. The number who obtained the Associateship of the Royal School of Mines from 1851 to 1881 was 198, of whom 39 were Government students, and of the Royal College of Science and Royal School of Mines from 1882 to 1897 the number was 525, of whom 323 were Government students. Of this total of 362 Government students 94 were Science teachers in training.

With regard to the Whitworth Scholarships, which, like the Exhibitions, depend upon success at the yearly examinations throughout the country, I may state that six have held their scholarships at the College for at least a part of the scholarship period, and three others were already associates.

So much for the prizemen we have with us. I next come to the teachers in training who come to us. The number of teachers in training who have passed through the College from 1872 to 1897 inclusive is about 600; on an average they attended about two years each. The number in the session 1872–73, when they were first admitted, was 16, the number in 1885–86 was 50, and in 1896–97 60. These have not as a rule taught Science Classes previously, but before admission they give an undertaking that they intend to teach. In the earlier years some did not carry out this undertaking, doubtless because of the small demand for teachers of Science at that time. But we have changed all that. With but very few exceptions, all the teachers so trained now at once begin teaching, and not necessarily in classes under the Department. It is worthy of note, too, that many Royal Exhibitioners and National Scholars, although under no obligation to do so, also take up Science teaching. It is probable that of all the Government students now who pass out of the College each year not less than three-fourths become teachers. The total number of teachers of Science engaged in classes under the Department alone at the present time is about 6000.

I have not yet exhausted what our College does for the national efforts in aiding the teaching of Science.

When you, gentlemen, leave us about the end of June for your well-earned holidays, a new task falls upon your professors in the shape of summer courses to teachers of Science Classes brought up by the Department from all parts of the four kingdoms to profit by the wealth of apparatus in the College and Museum, and the practical work which it alone renders possible.

The number of Science teachers who have thus attended the summer courses reaches 6200, but as many of these have attended more than one course the number of separate persons is not so large.

Research.

From time to time balances arise in the Scholarship fund owing to some of the National Scholarships or Royal Exhibitions being vacated before the full time for which they are tenable has expired. Scholarships are formed from these balances and awarded among those students who, having completed the full course of training for the Associateship, desire to study for another year at the College. *It is understood that the fourth year is to be employed in research in the subject of the Associateship.*

The gaining of one of the Remanet Scholarships, not more than two on the average annually, referred to, furnishes really the only means by which deserving students are enabled to pursue research in the College; as, although a professor has the power to nominate a student to a free place in his laboratory, very few of the most deserving students are able to avail themselves of the privilege owing to want of means.

The Department only very rarely sends students up as teachers in training for research work, but only those who intend making teaching their profession are eligible for these studentships.

I trust that at some future day, when we get our new buildings—it is impossible to do more than we do till we get them—more facilities for research may be provided, and even an extension of time allowed for it if necessary. I see no reason why some of the 1851 Exhibition Scholarships should not be awarded to students of this College, but to be eligible they must have published a research. Research should naturally form part of the work of the teachers in training who are not brought up here merely to effect an economy in the teaching staff.

Such, then, in brief, are some of our Normal School

attributes. I think any one who knows the facts must acknowledge that the organisation has justified itself not only by what it has done, but also by the outside activities it has set in motion. It is true that with regard to the system of examining school candidates by means of papers sent down from London, the Department was anticipated by the College of Preceptors in 1853, and by Oxford and Cambridge in 1858; but the action of 1861, when Science Classes open to everybody, was copied by Oxford and Cambridge in 1869. The Department's teachers got to work in 1860, but the so-called "University Extension Movement" dates only from 1873, and only quite recently have summer courses been started at Oxford and Cambridge.

The Chemical and Physical Laboratories, small though they were in the Department's schools, were in operation long before any practical work in these subjects was done either at Oxford or Cambridge. When the College laboratories began about 1853, they existed practically alone. From one point of view we should rejoice that they are now third rate. I think it would be wrong of me not to call your attention to the tenacity, the foresight, the skill, the unswerving patience, exhibited by those upon whom has fallen the duty of sailing the good ship "Scientific Instruction," launched as I have stated, out upon a sea which was certain from the history I have brought before you to be full of opposing currents.

I have had a statement prepared showing what the most distinguished of our old students and of those who have succeeded in the Department's examinations are now doing. The statement shows that those who have been responsible for our share in the progress of scientific instruction have no cause to be ashamed.

Conclusion.

I have referred previously to the questions of Secondary Education and of a true London University, soon, let us hope, to be realised.

Our College will be the first institution to gain from a proper system of Secondary Education, for the reason that scientific studies gain enormously by the results of literary culture, without which we can neither learn so thoroughly nor teach so effectively as one could wish.

To keep a proper mind-balance, engaged as we are here continuously in scientific thought, literature is essential, as essential as bodily exercise, and if I may be permitted to give you a little advice, I should say organise your athletics as students of the College, and organise your literature as individuals. I do not think you will gain so much by studying scientific books when away from here as you will by reading English and foreign classics, including a large number of works of imagination; and study French and German also in your holidays by taking short trips abroad.

With regard to the University. If it be properly organised, in the light of the latest German experience, with complete Science and Technical Faculties of the highest order, it should certainly insist upon annexing the School of Mines portion of our Institution; the past history of the School is so creditable that the new University for its own sake should insist upon such a course. It would be absurd, in the case of a nation which depends so much on mining and metallurgy, if these subjects were not taught in the chief national university, as the University of London must become.

But the London University, like the Paris University, if the little history of Science teaching I have given you is of any value, must leave our Normal College alone, at all events till we have more than trebled our present supply of Science teachers.

But while it would be madness to abolish such an institution as our Normal School, and undesirable if not impossible to graft it on the New University, our School, like its elder sister in Paris, should be enabled to gain by each increase in the teaching power of the University. The students on the scientific side of the Paris School, in spite of the fact that their studies and researches are looked after by fourteen professors entitled Maîtres de Conférences, attend certain of the courses at the Sorbonne and the Collége de France, and this is one of the reasons why many of the men and researches which have enriched French science, hail from the École Normale.

One word more. As I have pointed out, the French École Normale was the result of a revolution, I may now add that France since Sedan has been doing, and in a tremendous fashion, what, as I have told you, Prussia did after Jena. Let us not wait for disastrous defeats, either on the field of battle or of industry, to develop to the utmost our scientific establishments and so take our proper and complete place among the nations.

J. NORMAN LOCKYER.

FELLOWSHIPS FOR RESEARCH.

THE foundation of Research Fellowships by the Commissioners of the Exhibition of 1851 was in this country of the nature of an experiment. Many people more or less enamoured of the system in vogue at the universities, whereby a man is carried on from one examination grind to another, until his freshness and originality of mind are in great measure lost, looked at the scheme for Research Fellowships with distrust, and an inclination to foretell their failure. There might, it was said, be an able man here and there who is benefited by holding a Research Fellowship and who does good work while holding it, but, in general, maturity of mind and knowledge, and an accumulated fund of experience are necessary for the success of a scientific or literary investigator. There is truth in this, of course, but the scholastic training of the best men is frequently carried so far that all enthusiasm is killed out by examinations, or the mind has become too critical and fastidious for the work of original production or continuous investigation.

These prophecies have been falsified in the most conclusive way by the report of the Commissioners. They say that they have received from academic institutions all over the country unanimous testimony to the success of their system of Research Scholarships, and an analysis of the work done by the Research Scholars and their after careers shows that the success has been full and complete. A number of able young men, fairly well trained in theoretical and practical science, have been chosen from the best students of our provincial colleges and given the means of pursuing research, and therefore also higher study of the best kind, for two or three years at approved institutions at home and abroad. The Commissioners most wisely determine that the whole time of the scholars should be given to the research work undertaken, and have steadfastly refused to sanction the employment of their funds to enable students to prepare for University degrees. The scheme and its conditions were the subject of much criticism. It was objected that by spending time in research the prospects in life of such men would be injured, that it would be difficult for them after to find congenial employment. This fear has also proved groundless. Of the large number of young men who have been sent out by the Royal Commissioners nearly all have obtained appointments in which the knowledge, skill, and, above all, resource and self-dependence they have acquired will be of the utmost value. Many have returned to their old colleges to teach, and to encourage among the students rising among them that zeal for the advancement of science they have themselves imbibed, to be an example ever before the eyes of still younger men, and by their association with rising students to create an interest in scientific progress which the studies of the class-room often fail to arouse. Some

have been appointed to important educational posts at home and in the Colonies; others have gone to direct scientific industries and engineering achievements. In spite of the vaticinations of the doubters, the scheme of the Commissioners has succeeded far beyond the expectation of even those who most believed in it, and its remarkable record ought to be widely studied by all interested in the higher education of the country, and especially by those who have the privilege of guiding the policy of our universities.

A similar movement has been started by the youngest of our universities. The University of Wales has now got its curricula into full swing, and has already begun to form its roll of graduates. The question of post-graduate work, and especially of Fellowships for literary and scientific research, was raised at an early period in the discussion of regulations for degrees. There has been no matter before the senate or the court of greater or even approximately equal importance. For upon the decision of the authorities as to whether promising students should after taking their degrees go on to real post-graduate work, or, as is the case at too many places, be encouraged to enter again as undergraduates at some other university, generally either Oxford or Cambridge, rests the whole future of the newer universities as regards the higher learning. If it is regarded as the natural course for a graduate to enter again as a freshman at another university, an important stimulus towards providing the necessary staff and machinery for imparting the best and completest teaching in all subjects will be withdrawn from the colleges. The new universities may do some good to their localities by giving the ordinary education of a professional man, but, under such a policy, they will never become homes of learning and research. In fact these colleges, however well manned, will, as regards the higher work only, take the place of feeding schools for the old universities, and the time and energies of their professors will be occupied with the ignoble task, which might surely be left to the schools and the cramming shops, of striving for the credit of their colleges in the race for a good place in the record of scholarships won or in the list of examinational successes. Already one Oxford college has proposed to give scholarships to be confined to the best Welsh graduates, a plan well calculated to increase the number of First Classes in the schools obtained by that college, but certain, so far as it operates in this direction, to degrade the University of Wales. It is to be hoped that this proposal will receive no official countenance from the University itself.

It will be said that the degrees of the University of Wales have as yet little or no market value, and that the best students must go elsewhere to obtain degrees which have. This may be true; a university, like everything else, must begin; but the question arises, how is the university to form its reputation, and to confer a value on its degrees? Surely not by itself sending its best men to colleges on which their home academic training will only help to shed lustre, and to which not only their academic success, but all the credit of their after life will be attributed. The duty of the university is to itself, and relates not to the present merely, but also to the future. It has no right to imperil or delay any credit or renown there may be a possibility of its attaining; and if there is any lesson to be learned from the history of universities, it is that learning will refuse to grow within academic walls if aims are not high, and if teachers are content to see others doing their highest work.

Also, a new university should pursue this policy of high aims and resolute determination to do all that a university can do for learning and science, from the very beginning. It has a unique opportunity. It is free from the trammels of custom and prejudice, and the claims of vested interests. It can be guided by older institutions, but the guidance to be obtained from these is almost more often of the nature of warning than of example.

The contention that has been put forward, that this kind of migration to undergraduate work in honours schools elsewhere should be encouraged by the newer, and even some of the older universities of the country, and that they should aid it by the foundation of scholarships and prizes, rests on a confusion of ideas. It may sometimes be a good thing for students who are already graduates to go to Oxford or Cambridge, but the interests served are not those of the parent university, and it is not a thing for the university as such to assist. Funds for such a purpose should be provided by persons interested in the older universities, or in the students to be sent there.

The foundation of Research Fellowships has been undertaken by universities in America with great success. Witness the youthful vigour of Johns Hopkins, and the great and growing vigour of Harvard and Yale, and others in the United States. The plan has been several times proposed in this country, but never until in the scheme of the Commissioners for the Exhibition of 1851 has it had a practical trial. An important pronouncement in its favour was given a few days ago by Mr. Simon at Manchester, and there is reason to hope that it may be followed by some practical action at Owens College or in the Victoria University. A fund for five years has been subscribed chiefly in the court of the University of Wales, and at a forthcoming meeting an election of a Fellow will probably be made, and we trust that he will prove the first of a long succession of literary and scientific scholars of native growth. In spite of the proverb, there is much in a name, and it seems to us that no better name than Fellow could have been devised. By rigidly refusing to allow undergraduate work to be undertaken, and giving the style of a Research Fellow to the graduate appointed, the university assures three things: that he shall throughout his tenure of the Fellowship at home or abroad be identified with the parent university, that his status shall be clear, and that no one shall be appointed whose merit is not clear and unmistakable. The advantage to the colleges of having a number of young men aspiring to obtain these Fellowships will be immense, especially if, like the Exhibition of 1851 Commissioners, the authorities, where possible, take the successful prosecution of a research as the best evidence of his fitness to hold a Fellowship. Nothing encourages higher work or stimulates a teacher like the presence of young men looking eagerly forward to doing something for the advancement of knowledge. Nothing kills research among teachers like confinement to mere preparation for examinational tests, or is more soul destroying for both teacher and taught than the competition which goes on for the longest list of examination successes.

It has been said that men would be encouraged to begin too soon to do original work. This is surely a strange thing to say in the face of the history of learning and science. Some of the greatest discoverers have had little or no training of the ordinary scholastic kind, and it is doubtful if they would have been so successful if they had spent years in grinding for successive examinations. Surely, when a man has taken his B.A. or B.Sc. degree with, say, first class honours in the subject or subjects he has chosen to specialise in, he ought to be ready to make a beginning of research. It does not follow that his work will be unfruitful because his experience has been brief, or his knowledge lacks the width and depth it will subsequently acquire, and acquire all the more surely and truly, if his mind is fixed on discovery or the advancement of learning instead of on the attainment of merely another first class. Training long continued for examinations has killed much intellect; it has created none. Yet, like many another fetish, the

examination system lingers on, and yearly claims its victims.

The University of Wales is to be congratulated in that so far it has recognised no examinational post-graduate work at other universities as fit work for the graduates sent out to represent it in the academic world. If higher degrees than that of B.A., M.A., or B.Sc. are required by these, there are the degrees of D.Litt., and D.Sc. of their own university, which it is to be hoped will be given solely as a reward for meritorious research.

It is essential for success in research that the man should be started when his mind is fresh, and he has not had time to acquire that morbidly critical habit of mind which residence at some of the universities seems to encourage so much, and which has been so fatal to the performance of real work by many highly gifted men.

Research will encourage resource, and the application of knowledge to real problems will foster a dependence on self which cannot but be of the greatest value to the possessor. Going out into the world of learning in a self-respecting way, received with due recognition of the position he has attained by the university to which he goes to reside, he will gain experience of the world, and be less apt to show that limitation of mental horizon, and that superciliousness of intellect, so characteristic of many, though happily by no means of all, who have taken high honours at the old universities.

But the best answer to the contention that a long and arduous preparation beyond the Bachelor's degree is necessary for successful research is to be found in the fact that already the contrary has been demonstrated at the Welsh colleges. One young man of great promise did most excellent work in Germany in the difficult field of the study of old Celtic manuscripts, another has made his name known in physical research. Both have returned to their college to teach, and their presence has proved a stimulus and inspiration to others. If the example thus set is followed by others in the Welsh University, and the Fellowship system is allowed a patient and fair trial, the results cannot fail to be of the greatest benefit to all concerned. Knowledge will be increased, the University by respecting itself and its students will be respected and its work will be recognised, and its *alumni* will have no cause to complain of the estimation in which the public hold the credentials they have received from their *Alma Mater*.

A. GRAY.

NOTES.

THE meetings of the International Conference on Scientific Literature, held last week at the Royal Society, came to an end on Thursday. A list of the delegates appointed to attend the Conference appeared in last week's NATURE, with an account of the dinner given by the Royal Society in their honour. We hope shortly to give a report of the questions discussed and the resolutions adopted.

THE annual general meeting of the London Mathematical Society will be held on Thursday, November 10. Lord Kelvin has acceded to the request of the Council, and will be nominated for the office of President. Prof. H. Lamb, F.R.S., will be nominated for a Vice-Presidentship. The retiring members are Messrs. Jenkins and G. B. Mathews, F.R.S. The former thus severs his long connection of more than thirty years—he being almost an original member. Prof. Elliott, F.R S., has chosen for the subject of his address, "Some secondary needs and opportunities of English mathematicians."

WITH the object of comparing systems of electric traction suitable for use in London, the London County Council have consented to permit the London United Tramways Company to re-construct one section of their lines in the neighbourhood of Hammersmith on the overhead trolley system of electric traction, on condition that two other sections are laid down on the underground conduit plan.

IN his opening lecture to the engineering students at Cambridge on Friday last, October 14, Prof. Ewing intimated that the crowded state of their lecture-rooms and laboratories would soon be relieved. A gift of 5000*l.* had just been made for the addition of a new wing to the engineering laboratory in memory of the late Dr. John Hopkinson and of his son, John Gustave Hopkinson, who recently lost their lives in the Alps. Dr. Hopkinson's son was to have begun work at this time as a student of engineering at Cambridge. This splendid and welcome gift was made by Mrs. Hopkinson jointly with her son Bertram and her surviving daughter.

THE Harveian Oration was delivered at the Royal College of Physicians on Tuesday by Sir Dyce Duckworth, who, after urging the claims of the college to the consideration of generous benefactors, pointed out that Harvey had definitely charged them to encourage research. The lecturer is reported by the *Times* to have said that what were greatly needed now in England were research laboratories attached to hospital wards and *post-mortem* theatres, and also a select staff of fully trained investigators available for service throughout the Empire. It was surely humiliating that researches were permitted to be made for the public benefit in various parts of British territory by foreigners, while many of their countrymen and countrywomen, owing to ignorance and mawkish sentimentality, were doing their best to debar the training of such men in England. After alluding to the results of recent pathological research in regard to the preventive treatment of tuberculosis, Sir Dyce Duckworth observed that the Röntgen rays had as yet yielded little new information, and their therapeutic influence was not determined, but, according to Rieder, of Munich, the rays emitted from "hard," vacuum tubes killed bacteria. The influence of glycerine in destroying some of the most noxious microbes which gained access to ordinary vaccine lymph was very noteworthy, and he could not but imagine that this agent might yet be found of more extended usefulness as a bactericide. Expressing his private opinion, though he believed it to be shared by the majority of those he addressed, he did not hesitate to stigmatise the recent Vaccination Act as a piece of panic legislation, a lamentable concession to ignorance, fraught with serious peril to the whole community, and unworthy of the duty and dignity of any British Government. He closed with a brief appreciation of Harvey's chief scientific achievements, and of his great guiding principle, devotion to truth.

MR. W. H. PREECE, C.B., F.R.S., will deliver the inaugural address at the new session of the Institution of Civil Engineers, on Tuesday, November 1. The Council of the Institution have made the following awards out of the trust funds at their disposal for the purpose for original papers dealt with during the year 1897–98. The formal presentation will take place on November 1:—Telford medals and premiums—A. H. Preece (London) and H. C. Stanley (Brisbane, Queensland); Watt medals and premiums—H. L. Callendar, F.R.S. (London), and J. T. Nicolson (Montreal, Canada); George Stephenson medals and premiums—Whately Eliot (Plymouth), W. O. E. Meade-King (London), and W. P. Marshall (Birmingham); the Crampton prize—E. W. Anderson (Erith); Telford premiums—L. B. Atkinson (Cardiff), Henry Fowler (Horwich), W. L. Strange (Bombay), F. J. Waring (London), D. W. Brunton (Denver, U.S.), Wilfred Airy (London), E. M. Bryant (Newcastle-on-Tyne), D. B. Butler (London), and H. V. Champion (Victoria); the James Forrest medal—W. L. Brown (London); Miller prizes—C. E. Wolff (Derby), A. D.

Keigwin (Ashford), Harold Williams (Kingston), J. T. Morris (London), H. C. Adams (Birmingham), H. O. Eurich (Bradford), B. K. Adams (Colombo), A. B. E. Blackburn (Wednesbury), Thomas Carter (Newcastle), P. F. Story (Manchester), D. E. Lloyd-Davies (Bewdley), and Wilfred Hall (Corbridge-on-Tyne).

THE Hayden Memorial Award of the Philadelphia Academy of Natural Sciences has been made to Prof. Otto Martin Torell, formerly professor of zoology and geology at the University of Sweden, and late Chief of the Geological Survey of Sweden. Of his works, those which treat of the ice period are the most important. To these belong "Contribution to the molluscan fauna, with a general view of the natural state of the Arctic regions," "Investigations of the Ice Period," and "On the causes of glacial phenomena in the north-eastern portion of North America." Partly by these works and partly by lectures Torell has, in Sweden as abroad, actively assisted in making known the theory that the territory of northern Europe, where great blocks of Scandinavian rocks have been found, was formerly covered by land ice, extending from Scandinavia, like the ice in Greenland at the present time, and not, as had been formerly supposed, by a frozen sea (Eismeer). Dr. Torell is a member of the Royal Society of Sciences of Sweden (1870), of the Agricultural Academy (1872), and of many other scientific societies in Sweden and abroad. He is Commander of the Swedish "North Star," Grand Officer of the Italian Order of the Crown, Knight of the second class of the Russian Order of St. Anna, Commander of the Danish Dannébrog, Officer of Public Instruction, and Officier de la Legion d'honneur.

FROM the report of the Laboratories Committee, presented at the quarterly meeting of the Council of the Royal College of Surgeons of England, held on Tuesday, it appears that since June 3 last 7050 doses of antitoxin, each containing 2000 units, and 2325 doses, each containing 4000 units, for the treatment of diphtheria in the hospitals of the Metropolitan Asylums Board, have been supplied, and all demands fully met. In deference to the researches in connection with the grant from the Goldsmiths' Company, Dr. T. G. Brodie and Dr. Cartwright Wood have continued their investigations and have planned out a further series of experiments for the coming winter. The Committee has awarded to each of them a further sum of 50*l.* from the research grant, as a recognition of their valuable work. Dr. T. G. Brodie is at present engaged on the chemistry of diphtheria antitoxin, and Dr. Cartwright on diphtheria toxins and antitoxins, and a method of examining water bacteriologically. The demand for antitoxin supplied to general and children's hospitals in London, in accordance with the conditions of the grant from the Goldsmiths' Company for use among the poorer classes of the community, is steadily increasing.

THE death is announced of Prof. Andreas Arzruni, professor of mineralogy and petrography in the Technical High School at Aachen, and of Dr. C. G. Gibeli, professor o botany and director of the Botanical Institute at Turin.

A MEETING of the Physical Society will be held on Friday, October 28. The papers down for reading are: An influence machine, by Mr. W. R. Pidgeon; the repetition of an experiment on the magneto-optic phenomenon discovered by Righi, by Prof. Silvanus P. Thompson, F.R.S.; the magnetic fluxes in meters and other electrical instruments, by Mr. Albert Campbell.

THE following meetings of the Royal Photographic Society are announced:—Technical meeting, Tuesday, October 25, "On the alleged discovery of photography in 1727," by R. B. Litchfield; "On the grain of photographic negatives," by E. Duncan Stoney. On Monday, October 31, slides will be shown by members of affiliated societies at the exhibition of the Royal Photographic Society.

THE *Athenæum* states that the Vienna Academy of Sciences has chartered the Swedish steamship *Gottfried* for its projected scientific expedition to South Arabia. The ship is expected to arrive in a few days at Trieste, where the members of the expedition will go on board. The leader of the party is Count Carl Landberg, the Bavarian Orientalist, who has already spent several winters in the district. Dr. H. Müller proposes to devote his researches to the Sabæan inscriptions and the pre-Arabic archæology. Prof. Simony will accompany the expedition as botanist, Dr. Cossmat as geologist, and Mr. Bury will be the leader of the caravan. Dr. Jahn will take as his speciality the study of the Mahra language. Dr. Layn goes as physician to the expedition.

WE learn from *Science* that, through the generosity of Mr. Cornelius Vanderbilt, the New York Botanical Garden is about to undertake a botanical exploration of the island of Porto Rico. The expedition, which is now being organised, will leave for the new Colony within a few weeks, and will be occupied in collecting museum and herbarium specimens and living plants for at least six months. Inasmuch as very little is yet known concerning the natural flora of the island, it is confidently expected that much of value and interest will be secured, and the collections will furnish the basis of a report on the botany and vegetable productions of our newly-acquired territory.—During the past summer much progress has been made in the New York Botanical Garden, in Bronx Park. The construction of the museum building has proceeded rapidly, three-fourths of its steel frame being in place, the walls being completed as far as the second story. The warm and wet summer has been favourable to the plants. Much progress has been made in planting the border, which will be completed during the autumn. It will be about two miles in length, and will contain some three hundred and fifty varieties of trees and shrubs.

AN instructive and interesting account of the cultivation of plants yielding Parà rubber, the collection and preparation of the rubber, and other aspects of the industry, is given in the *Kew Bulletin* for October. With regard to future prospects of the rubber from the vast region drained by the Amazon, Mr. Consul W. A. Churchill is quoted to have remarked as follows, in a recent report to the Foreign Office:—"Some people suppose that the supply of Amazonian rubber may become exhausted in the near future. The most competent authorities are not at all of this opinion, but maintain that the supply is inexhaustible, because the *Hevea* is continually being reproduced by nature. Certainly some areas become exhausted when overworked, but when left alone for some time they recover. . . . The area that is known to produce Pará rubber amounts to at least 1,000,000 square miles. Further exploration will, no doubt, show that this area is under-estimated." The introduction of the rubber-yielding trees of tropical America to British Possessions in the East was an enterprise in which, more than twenty years ago, Kew took an active part, the expense being borne by the Government of India. A survey of the results of experiments carried out in various places in which the cultivation of rubber has been attempted, is given in the present number of the *Bulletin*.

IN a recent paper on "The accepted altitude of the Aurora Borealis," read by Prof. Cleveland Abbe before the American Philosophical Society, he stated that some observers have seen the light in such positions between themselves and neighbouring objects as to demonstrate that the aurora, like the lightning, may be entirely confined to the lowest stratum. Others have

seen it so located among the clouds that its origin must be placed at or below their level, and, therefore, within a few thousand feet of the earth's surface. On the other hand, those who have calculated the altitudes of specific beams by trigonometrical or equivalent methods have deduced heights of twenty to a hundred miles; Dr. Boller has even quoted an altitude of 1243 miles. Prof. Abbe remarks that, after reviewing the literature of the subject since the time of Halley, he finds that all methods agree in one fundamental assumption that the observed beams and arches have an individual existence and a definite *locus*. But this assumption is negatived by the equal frequency of negative and positive parallaxes wherever the parallax method is applied. The only conclusion possible is that the observers do not see the same object, partly because the aurora is too low down, and partly because there are optical illusions due to alignment.

DURING the present year, Dr. Doberck, Director of the Hong Kong Observatory, published a useful pamphlet on "The law of storms in the Eastern seas," the first part of which was issued in 1886. The work is illustrated by plates showing the different classes of typhoons, and their average tracks and rate of progress, based upon 244 storms registered during the past thirteen years. A translation of the pamphlet by Dr. P. Bergholz, of Bremen, appeared in the *Meteorologische Zeitschrift* for September, thus testifying to the value of Dr. Doberck's investigations to the sea-faring community, and to maritime meteorology generally.

THE special Antarctic number of the *Scottish Geographical Magazine* ought to be widely distributed and read, in order to excite a little more practical sympathy with scientific Antarctic exploration than has yet been shown by the general public. Sir John Murray pleads strongly for a British Antarctic Expedition. At the present moment, he points out, scientific men in Germany are making arrangements, with the approval and support of their Government, for the exploration of the Antarctic in the year 1900. We have been asked to co-operate, at the same time, in this exploration, but our Government has expressed itself unable to support the undertaking, and there is little hope of the necessary funds being procured from private sources. The outlook is thus not at all promising so far as British science is concerned; and unless the unexpected happens, we shall have to stand aside while other countries carry through the great work of examining the south polar area, and reap the results of their enterprise. Sir John Murray suggests that a rich man, or several rich men, should place in the hands of the President of the Royal Society at least 100,000*l.* for the purpose of organising an Antarctic expedition to co-operate with the other expeditions that are preparing to set out in the year 1900. Here is a splendid opportunity for wealth to assist most usefully in the development of knowledge, and earn renown for British science. May the desire to place our country in the fore-front in scientific research, and especially in oceanic explorations, move some generous benefactor to provide means for equipping and sustaining an expedition which will be a credit to the nation and to science. The whole history of Antarctic exploration, including complete reports of the discussion of the subject at the Royal Society on February 24 (see NATURE, vol. lvii. pp. 420-427), and an excellent map of the south polar regions, is given in the *Scottish Geographical Magazine*, and we trust its publication will produce a practical result.

The August number of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (Paris) is occupied almost entirely by an article by M. L. de Chasseloup-Laubat, on the steamboat service of this country, the United States, Germany and France. The development of steam navigation is traced, and full descriptions given of all the principal steamers which have been engaged in the passenger service of the world, and of some cargo boats. The article contains detailed particulars of the dimensions of the boats, mode of construction, engines and fittings, speed and draught. In some of the more modern boats, such as the *Campania*, particulars are given of the staff and crew engaged in working the boats, and the quantity of coal and provisions used. From the tables given it appears that for the number of cabin passengers carried the American Line stands first, followed in order by the Cunard, White Star, Hamburg-American and Norddeutscher Lloyd. The German boats carry the greatest number of emigrants. The article is very fully illustrated, and contains several tables as to the time occupied in the different voyages, details of dimensions, horse-power and other matters.

A MAGNIFICENT meteor was observed at numerous points in Ontario, at 8.50 standard time of July 5, and many descriptions of it appeared in the newspapers at the time. Mr. F. F. Payne gives a few particulars of the meteor in the July number of the Canadian *Monthly Weather Review*, which has just reached this country. The meteor was described by observers as a ball of lurid light, apparently about ten inches in diameter, exploding with a loud rumbling noise like thunder, and leaving a long sinuous trail of white vapour, which was visible for at least six minutes afterwards. As is usual there was some apparent disagreement between observers as to the meteor's flight, the popular opinion prevailing that its course must be parallel to the earth's surface, its vertical motion scarcely being considered. From data received, Mr. Payne thinks that the meteor became visible at a height of 125 miles above the earth's surface at a point somewhat to the eastward of Collingwood, over which place it passed near the zenith, its path being inclined a little to the north of west. It apparently exploded over the Georgian Bay in latitude 44° 50′, longitude 80° 30′, and the observer at Collingwood states that "a loud rumbling noise was heard."

THE question of the determination of the neutral elements of involutions presents considerable difficulties to the mathematician. An important contribution to the solution of this problem is given by M. F. Deruyts, of the University of Liége, in the *Bulletin* of the Belgian Academy. The same mathematician also considers certain properties of gauche curves, his conclusions including amongst others the following interesting result:—"Through $9 - k$ points of space there can be drawn

$$2(k - p + 1)\binom{2n - k + 1}{p}\binom{2n - k}{p - 2},$$

gauche curves of the fourth order having contact of order $(k - p + 1)$ with a given gauche curve of order n, and meeting this curve in $2p - 3$ points."

THE installation of a storage battery of ten thousand cells has enabled Prof. John Trowbridge to undertake an inquiry into the nature of electrical discharges in air and gases under conditions which render the investigation practically an incursion into a new region of research. The results of his investigations have on several occasions been referred to in these columns; nevertheless the following *résumé* of certain conclusions, from his paper in the *Proceedings* of the American Academy of Arts and Sciences, vol. xxxiii. No. 21, is of interest:—Beyond 1,000,000 volts the initial resistance of atmospheric air to electric discharge decreases, and may become as low as 1000 ohms between terminals 2 or 3 inches apart. When the initial resistance of highly rarefied air is broken down by x-rays, it exhibits less resistance than it does at 2 mm. pressure when its conductivity is generally considered to be greatest. There are anode as well as kathode x-rays, and these rays exhibit all the peculiarities of the kathode rays. The x-rays can be distinctly produced with an electromotive force of 10,000 volts, and there are indications of them at 5000 volts. Electrostatic induction

is an important phenomenon in that of x-rays; experiments indicate that these rays are evidence of an electromagnetic disturbance, which therefore travels with the velocity of light, and is accompanied by molecular excitation. The mechanism of the production of x-rays appears to be a setting-up of electrostatic lines of induction, and a production of an electromagnetic wave or impulse; the stress in the medium reduces its resistance, and the x-radiations become less and less energetic after a certain interval the longer the Crookes' tube is excited. The behaviour of rarefied media to powerful electric stress is analogous to that of elastic solids to mechanical stresses; a so-called vacuum, which acts as an insulator for electromotive forces giving a spark of 8 inches in air (about 200,000 volts), breaks down under 3,000,000 volts. A single discharge with this voltage through highly rarefied media produces x-rays powerful enough to give a photograph of the bones of the hand in one-millionth of a second. During the discharge the apparent resistance of the medium is only a few ohms. In this case the medium seems completely to lose its elasticity, so to speak, and is ruptured, and the elastic solid analogy thus seems to elucidate the question of the electrical conductivity of the ether.

MR. D. E. HUTCHINS, Conservator of Forests at the Cape, recently read before the Cape Town Philosophical Society a paper showing the need and value of extending the area in the Colony at present under forest. Cape Colony stands far below other countries in its proportion of forest, though the climate of the country is such that it ought to have a percentage under forest at least equal to Germany. The following table shows the area under forest in the Colony compared with that in some other countries:—

Countries.	Area under forest in acres.	Percentage under forest of total area of country.
Russia in Europe ...	...527,427,000	... 42
Sweden	... 42,366,000	... 42
Austria	... 46,856,000	... 31
Germany	... 34,350,000	... 26
Norway	... 18,920,000	... 25
India	...140,000,000	... 25
France	... 20,750,000	... 16
Portugal	... 1,666,000	... 5
Great Britain and Ireland	... 2,790,000	... 4
Cape Colony	.. 353,280	... 0·29

Mr. Hutchins suggests that plantations should be formed in districts within minimum rainfall limits of 15 or 20 inches per annum. The argument which will perhaps appeal most forcibly to Cape agriculturists is that while the total value of the fruit produced in Cape Colony is 100,000*l.*, no less than 269,349*l.* have been paid for wood imported into the Colony during the last two years, nearly the whole of which would be produced in national forests covering an area of about 50,000 acres. That forests can thrive where agriculture is difficult or impossible, is shown by the steep richly-wooded slopes of the lofty Amatolas, the similarly beautiful forest with its gigantic yellow-wood trees in the barren Knysna country, and, perhaps most striking of all, the cedar trees of Clanwilliam, growing on the absolutely bare rocks of the stupendous Cedarberg Range; while at Genadendal an introduced tree, the cluster pine, hardier than any of the indigenous trees, is spreading itself self-sown up the rocky mountain-side, in spite of fires, drought, hot winds and climatic vicissitudes, that are too often the despair of the agriculturist.

A PAPER on the "Wanton Mutilation of Animals," contributed by Dr. George Fleming to the *Nineteenth Century* for March 1895, has been issued in separate form by the Royal Society for the Prevention of Cruelty to Animals. The paper shows that many mutilations of this kind can boast of a venerable antiquity, and are practised in many countries. The practice of removing a portion of the tails of certain breeds of dogs appears to have been instituted as a means for the prevention of rabies, the belief being that the sinew which followed the piece bitten off was a worm which produced madness. "Worming," which was performed upon dogs for the same purpose, consisted in the excision of the frænum of the dog's tongue, under the impression that it had something to do with madness. Ear-cropping of dogs has been carried on for two or three centuries. Horses are subjected to tail-docking, ear-cropping, nostril-slitting, and other unnecessary mutilations. The fashion of mutilating horses appears to have prevailed at a very early date in England, and may have been introduced from Germany or Scandinavia. Dr. Fleming's descriptions will assist in suppressing these cruel and useless practices.

MESSRS. WILLIAMS AND NORGATE'S Book Circular for October, and their latest list of second-hand books (No. 10), contain the titles of a number of volumes on scientific subjects. —A more elaborate catalogue, occupying 686 pp., is the new volume of "Naturae Novitates" just issued by Messrs. R. Friedländer and Son, Berlin. This publication not only contains classified lists of books in many languages on all branches of science, but the works named in it are indexed according to subjects and authors.

THE following official publications from our foreign possessions have reached us:—*The Central Africa British Gazette* (published at Zomba) for July 9, containing an interesting report on the cultivation of coffee, compiled by the Commissioner of Agriculture to the Hawaiian Government; Report on the Botanic Gardens and Domains, New South Wales, for the year 1897, by the Director, Mr. J. H. Maiden; Annual Report of the Royal Botanic Garden, Calcutta, for the year 1897–98, by the Superintendent, Dr. D. Prain, chiefly occupied by a list of exchanges; *Bulletin* (No. 15) of Miscellaneous Information from the Royal Botanic Gardens, Trinidad, edited by the Superintendent, Mr. J. H. Hart, and consisting of a conspectus of the genera of Ferns and Fern-allies of the Colony, and a monograph of the Cyatheaceæ, comprising the genera *Alsophila* (14 sp.), *Hemitelia* (15 sp.), and *Cyathea* (25 sp.); *Circular*, Nos. 4–7, of the Royal Botanic Gardens, Ceylon, issued by the Director, Mr. J. C. Willis, in which the extension of the rubber cultivation in the island is advocated, especially that of the Parà rubber, *Hevea brasiliensis*, which is stated to be well suited to the climate of the low country in the south-west of Ceylon.

THE additions to the Zoological Society's Gardens during the past week include a Tantalus Monkey (*Cercopithecus tantalus*, ♂) from Lagos, presented by Mr. Arthur T. Warren; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr H. W. Mote; two American Flying Squirrels (*Sciuropterus volucella*) from North America, presented by Mrs. Nias; a Bengalese Cat (*Felis bengalensis*) from the East Indies, presented by Mr. David J. Munro; a Ruddy Ichneumon (*Herpestes smithi*) from India, presented by Mr. J. Lyons; a Black-headed Lemur (*Lemur brunneus*) from Madagascar, deposited; an Eland (*Orias canna*, ♂), bred in France purchased.

OUR ASTRONOMICAL COLUMN.

THE ANDROMEDA NEBULA.—In this column (September 22, p. 515) we have previously referred to the telegram which informed us that M. Seraphimoff had discovered, near the centre of the nebula of Andromeda, a stellar-like condensation. Writing to the *Astr. Nachr.* (No. 3523), he states that the central condensation is no nebulous nucleus, but is quite a distinct star of magnitude 10–11. Measurements with a star of magnitude 11 in the neighbourhood showed that the observed

object is exactly identical in position with that of the old nucleus.

M. Seraphimoff also mentions that an examination of all photographs, drawings and descriptions of this nebula shows that the central part was very seldom referred to as a small star. In the year 1885 numerous observations (*Astr. Nachr.*, vol. cxii.-cxv.) showed that the central portion had a different appearance to what it now has; at the present time the two small stars appear equally bright and sharp, and this has been corroborated by Profs. Backlund, Belopolsky and Morin.

That the central portion of this great nebula is variable there can be little doubt, but up to the present time only very small differences of intensities have been recorded.

Prof. Pickering, in a Harvard College *Circular*, No. 34, states that a comparison of photographs of the nebula taken with the 8-inch and 11-inch Draper telescopes on September 20 and 21, 1898, with similar photographs taken in 1893-96, fails to show the new stellated appearance.

ATLAS OF VARIABLE STARS.—In a recent number of the *Astr. Nachr.* (No. 3523), Dr. J. G. Hagen describes the arrangement of a new atlas of variable stars, which we hope will soon be published, as it promises to be a very useful addition to an astronomical observatory. When completed the chart will consist of five series, the first three showing, on separate sheets, the positions and neighbouring stars of variables with faint minima; the fourth series of charts is for variables observable with small instruments; and the fifth, for naked eye variables. The sample chart accompanying Dr. Hagen's notice gives one an idea of the completeness of the work undertaken. The zones included in the first three series are $-25°$ to $0°$, $0°$ to $+25°$, and $+25°$ to $90°$, and will cover altogether 150 charts. These charts include a field of one square degree, with an inner square of half the sides. On the outer side of the small square only stars of the BD are inserted. In the inner square all stars are inserted which appear in a 12-inch with a magnifier of 45 and a measurable field of $0°.75$.

The variable, with one exception, on each chart is situated in the middle, so that the observer will be able directly to recognise in his field of view which of the stars is the variable in question.

Each chart, further, gives the coordinates of the variable for 1900, with the annual movements, and, in addition, the colour, type of spectrum according to Secchi's classification, and the magnitudes at maximum and minimum. We may mention that each chart will be mounted on good stiff cardboard, and being of a handy size can be held by or placed close to the observer at the eye end of the telescope.

In conclusion, it must be remembered that the publication of this fine series of working charts is a very costly affair, and would probably not have been accomplished had not the benevolent Miss Catherine Bruce taken her usual interest in the progress of astronomical science, and tendered considerable financial help to further the printing of them.

REMINISCENCES OF AN ASTRONOMER.—Prof. Simon Newcomb continues his reminiscences in the third of a series of articles to the October number of the *Atlantic Monthly*. He commences in this number with his visit to Paris to search among the old manuscripts of the Paris Observatory for early observations of occultations which had never been published. We may here point out how important it is to keep a record of every observation that is made, no matter whether at the time it be considered useful or not. The study of what may now seem apparently useless may, for all we know, in years to come, become of vital importance. Such was the case with the old observations of occultations made at the Paris Observatory. "The astronomers had no idea of the possible usefulness and value of what they were recording. So far as we can infer from their work, they made the observations merely because an occultation was an interesting thing to see; and they were men of sufficient scientific experience and training to have acquired the excellent habit of noting the time at which a phenomenon was observed." By means of these old observations "seventy-five years were added, at a single step, to the period during which the history of the moon's motion could be written. Previously this history was supposed to commence with the observations of Bradley, at Greenwich, about 1750; now it was extended back to 1675, and with a less degree of accuracy, thirty years further still."

Referring to a meeting of the Academy of Sciences which he attended four years later, he says: "In the course of the session a rustle of attention spread over the room, as all eyes were turned upon a member who was entering rather late. Looking towards the door, I saw a man of sixty, a decided blond, with light chestnut hair turning grey, a slender form, a shaven face, rather pale and thin, but very attractive and extremely intelligent features. As he passed to his seat hands were stretched out on all sides to greet him, and not until he sat down did the bustle caused by his entrance subside. He was evidently a notable.

"Who is that?" I said to my neighbour.

"'Leverrier.'"

Prof. Newcomb found Delaunay one of the most kindly and most attractive of men. "His investigation of the moon's motion is one of the most extraordinary pieces of mathematical work ever turned out by a single person. It fills two quarto volumes, and the reader who attempts to go through any part of the calculations will wonder how one man could do the work in a life-time."

After the death of Delaunay, who was drowned when out for a sail in a small boat, Leverrier was reappointed to his old place at the Paris Observatory, and to him, as Prof. Newcomb says, "belongs the credit of having been the real organiser of the Paris Observatory. His work there was not dissimilar to that of Airy at Greenwich; but he had a much more difficult task before him, and was less fitted to grapple with it."

LORD LISTER ON EXPERIMENTAL MEDICINE.

THE address delivered by Lord Lister at Liverpool on October 8, on the occasion of the opening of the Thompson-Yates Laboratories at the University College in that city, was briefly referred to in our report of the ceremony last week. The complete address is printed in the *British Medical Journal* of October 15, and is reproduced below. It is a statement as to the nature and value of the work to be carried on in the new laboratories, and a dignified vindication of the experimental method in medicine. The facts concerning experiments upon animals are so often presented to the public in a distorted form, that a calm exposition of the true ethical policy of vivisection, such as Lord Lister gives in his address, should have a most beneficial effect.

LORD LISTER'S ADDRESS.

My Lord Chancellor, my Lord Mayor, my lords, ladies, and gentlemen,—When I was honoured by the authorities of the Liverpool College with the request that I would open the Thompson-Yates Laboratories I little imagined that I was asked to take part in so imposing a ceremonial as the present. That it should have assumed such a character, that it should have attracted so large and brilliant a company, including not only many men from various and often distant parts of the country distinguished in medicine and other branches of science, but also noblemen, Church dignitaries, and persons eminent in literature and in politics, seems to me a matter of great importance, full of good augury for the future of the scientific practice of the healing art—in other words, treatment based on real knowledge as contrasted with the blind gropings of empiricism. We seem to have before us to-day clear evidence that the more cultured sections of the British public are becoming alive to the necessity for providing adequate means for the practical study of the sciences which are of the very essence of the knowledge that confers the power to recognise and treat disease. If an engineer is to qualify himself for detecting and correcting anything wrong in a machine of human construction, no verbal description or drawings will give him the requisite information; he must see and handle the details of the mechanism, and watch them at work. And it might seem the veriest common sense that the more practically familiar a man is with the structure and working of that marvellously complicated mechanism, the human body, the better fitted will he be to deal with its disorders. Yet obvious as such a consideration may seem, it is only in comparatively recent periods that its truth has been generally recognised. I am old enough to remember the years before the passing of the Anatomy Act, and I recollect being told as a child of the fiendish deeds of Burke and Hare, horrors which it would appear were needed to arouse a prejudiced and apathetic public to the imperious necessity of making it legally permissible for the intending surgeon to become acquainted in the only possible way, by

dissection, with the sacred structures which he would be called upon to invade with his knife in the living body. A dissecting room well provided with the needful material for study has since been an essential equipment of every medical school, and a thorough course of dissection is demanded of every medical student. Meanwhile another kind of anatomy than that which the scalpel displays has come into being—the anatomy which the microscope has revealed and is constantly further revealing. This microscopic anatomy both of healthy and of diseased structures has assumed the greatest importance, and like naked-eye anatomy it requires special provision for its successful study. The materials to be studied cannot well be obtained by the student in his lodgings, and the processes employed for the elucidation of their minute structure are often of a complicated character which he cannot learn unaided, and require costly apparatus which he cannot provide. The requisite facilities for this work will be amply supplied by the laboratories which are to be opened to-day. The necessity for special pathological institutions has long been recognised on the continent, and nowhere has such an establishment been conducted with more signal success than in the Pathologisches Institut of Berlin, presided over for many long years by the illustrious man whom Liverpool is, I am sure, as glad to welcome with reverence as London has been. Many present to-day have sat at the feet of Prof. Virchow, but we may fairly anticipate that Liverpool students at all events will for the future be able to dispense with these pilgrimages to Germany. While the minute anatomy of normal and morbid structures will be thus effectively taught in the new laboratories, much may also be done in them to demonstrate and explain the actions of the living organism. I well remember the effect produced upon me as a member of Dr. Sharpey's class in London, by the repetition before us of Bernard's great experiment on the local circulation, and the converse experiment of Waller. The sympathetic nerve in the neck of an animal being divided, the ear of that side instantly became red and hot, and the blood vessels turgid; while on the application of galvanism to the severed nerve the opposite effect immediately followed, the ear becoming white and cool, and the vessels less conspicuous than those of the other side. Thus was impressed upon us, as mere oral teaching could hardly have done, the immensely important fact that the contractions of the arteries are as much under the control of the nervous system as are those of the muscles of a limb. I need, perhaps, hardly add that the animal being completely under an anæsthetic during such a demonstration no pain whatever is inflicted. In the study of the new science of bacteriology the pathological laboratory will render most important service. The student will see with his own eyes by aid of the microscope the minute living beings which we now know to constitute the essential cause of many infectious diseases, and he will be put through a course of the cultivation of these microbes, which, while it will impress upon him the reality of their existence, and the characters by which the various species may be recognised, will be invaluable as an exercise of the habits of accurate observation and manipulative skill. The new laboratories will also serve as a centre to which practitioners of a wide surrounding district may refer for the authoritative determination of the nature of doubtful specimens of diseased material, which they have neither the needful equipment, time, nor special knowledge to decide for themselves. As important as the services which the laboratories will render to education and medical practice will be the opportunities which they will afford for research. I had occasion, in the address which I gave two years ago in this city, to refer to some of the benefits which have been secured to mankind by recent biological investigation, and I need not say more on the subject at present; but I would remark that every step in advance in science only opens up wider fields for exploring the infinite resources of nature; and these laboratories will afford ample means for the further prosecution of such beneficent inquiries. Some, perhaps, may be disposed to object to such researches because they involve the sacrifice of animal life. This, however, I need hardly remark, is as nothing compared to what occurs for the supply of food to man. Of animal suffering I need hardly speak, because, in truth, the actual pain involved in these investigations is commonly of the most trifling description. Anæsthesia has come to the aid of experiment on animals, as the electric telegraph did for railways. Anæsthesia enables needful operations to be done without disturbance from the struggles of the animal, while it affords to the operator the unspeakable comfort of knowing that he inflicts no pain. I am bound to add that antiseptic treatment of the wounds has had a similar doubly beneficial influence. By preventing inflammation it renders healing painless, while it leaves the parts uncomplicated by inflammatory changes, and allows the results of operative procedure to be rightly estimated. I greatly surprised a former Chancellor of the Exchequer when, on a deputation to him on this subject, I explained to him that operations for the removal of parts of the brain of monkeys, which he had imagined to be attended with horrible torture, had, thanks to anæsthetics and antiseptics, been probably from the first to last unattended with a twinge of pain. Such operations thus painlessly conducted have, by indicating the precise functions of different parts of the organ, and thus guiding the surgeon in his operations, already led to the saving of many human lives. While I deeply respect the humane feelings of those who object to this class of inquiry, I would assure them that, if they knew the truth, they would commend and not condemn them. The laboratories, though they will be formally opened to-day, have for some time past been in practical operation; with the result that the Biological and Pathological School of Liverpool is already ranking very high among similar institutions in other parts of the world. As an illustration I may mention the fact that a committee of the Royal Society, with the approval of the Secretary of State for the Colonies, has lately selected a pupil of this school as one of two men specially qualified to undertake investigations in Africa on the deadly malaria of those regions. I cannot conclude these remarks without congratulating the Liverpool College on the mighty addition which these laboratories afford to their powers for usefulness. I believe they may be pronounced, both in structure and equipment, equal to any in existence. I must also congratulate you on having so nobly generous a benefactor as Mr. Thompson-Yates. I trust he will be rewarded by the deep satisfaction of knowing that he is doing incalculable good to mankind. If I may make one more observation, it is that while the laboratories have been so nobly constructed and equipped, there is yet much to be desired as regards the means for maintaining them in efficiency; and if any wealthy inhabitant of Liverpool is anxious to bestow his wealth in some manner calculated to do good to his fellow-men, he could hardly do better than by devoting a portion of his resources to the permanent maintenance of these fine institutions.

MECHANICS AT THE BRITISH ASSOCIATION.

THOUGH an admirable President had been secured in Sir John Wolfe Barry, the proceedings in this Section were not up to the usual standard either in interest or importance to the profession. The fact of the matter is that, as in other Sections, too many papers are accepted, involving inordinately long sittings and often tending to hinder due discussion of really valuable papers. Unless the communications are mere notes of some scientific discovery or fact, the programme should be so arranged that not more than four papers are put down for any one day. The organising committee should insist that at least half a dozen copies of any paper intended for reading should be in the hands of the recorder a month before the opening of the meeting: the recorder could then circulate these copies, with a note of the day on which the paper would be taken, amongst those engineers most capable of discussing satisfactorily the facts and conclusions of the author, with a request from the organising committee that they should attend and take part in the discussion. The President would thus have a list of those he could call upon to speak on any paper, and the speakers having had an opportunity of preparing their remarks beforehand, a really valuable discussion would be secured. Few men are able to get up and discuss off-hand a scientific paper, which they have had no opportunity of studying, especially when it has been read often at great speed in an almost inaudible tone; the result is that we have the poor discussions which so often take all the life out of the proceedings in Section G.

At the Institution of Civil Engineers printed copies of the papers are always circulated a week or two beforehand, and no effort is spared to secure the attendance of every one capable of throwing any light upon the subject under consideration. As a

result discussions often extend over two successive meetings of the Institution. Perhaps the organising committee may be able to do something in this line before the next meeting, and renewed efforts should be made to secure papers from the workers in the engineering laboratories which are such a feature now of all our universities and university colleges. All attempts to secure such help during the past few years have met with most disheartening refusals.

The most important point raised by the President in his valuable address was the suggestion that in order to enable funds to be cheaply raised to carry out the deepening and enlarging of our docks, the great railway companies should practically take over the control of the harbours and docks which they respectively serve. It was pointed out that every year saw an increase in the over-all dimensions not only of ocean liners, but of the ordinary cargo boats; this means that most of the dock authorities will within the next few years have to face very heavy expenditure in enlarging and deepening locks and their water approaches. Sir John doubted if this increased capital would be able to earn a fair interest, and claimed that if they were administered by the railway companies there was more chance of both diminishing establishment charges and of securing a sufficient inducement for the public to invest, on the faith of this new security. He indicated ways of preventing the growth of a dangerous monopoly, but it is very doubtful whether the public would willingly see such an amalgamation; there is already an indictment against the railways of strangling many industries by their excessive charges for carriage of goods, and curiously enough Mr. Forster Brown, in a thoughtful paper on "The economic and mechanical features of the coal question," advocated strongly the State purchase of railways in order to bring about a reduction of freight charges, and thus to make good the ever growing cost of production owing to deeper and thinner seams having to be worked. In the discussion on Mr. Brown's paper several of the speakers reluctantly confessed they were gradually drifting to State purchase as a necessity sooner or later, but the President opposed the proposal very strongly.

The outstanding feature in the proceedings of the Section was the constant cropping up of this all-important question of facilitating the carriage from the sea-board to the factory of the raw products of our great manufactures, and the return transit of the manufactured goods. The extraordinary growth of the manufactures and commerce of Germany during the last twenty years, the still more rapid strides which have been made in the United States during the same period, are forcing us to realise that our supremacy is being challenged in every quarter of the globe; this is the justification of the feverish haste with which schemes are being pressed forward to enlarge our dock facilities, to increase their equipment, and to connect our great inland manufacturing centres to the sea-board by canals suitable for sea-going vessels. The cost of carriage must at all hazards be reduced, hence the papers by Mr. R. C. H. Davison on the new works at Barry Docks (visited by the Section on the Saturday), by Prof. Ryan on Welsh methods of shipping coal, by Mr. Marten on a scheme for the improvement of the waterway between the Bristol Channel and the Birmingham district, and by Mr. Allen on electric canal haulage, and also the paper by Mr. Brown, already alluded to. It was not so much the mechanical and engineering details described in these papers, important though they were, which interested the audiences and gave rise to discussion, but the economic features of the one problem common to them all—the cheapening of the carriage of our raw products and our manufactures. Industrial legislation during recent years, and the upward tendency of wages of skilled labour render inevitable a reduction in some other direction to counterbalance the increased cost of production brought about by the above two tendencies. The two directions in which this reduction can be obtained most readily are in the increase of labour-saving appliances in the process of manufacture, and a lessening the cost of the raw product by facilitating and cheapening its carriage; this latter saving again coming to the help of the manufacturer in the diminishing of the carriage charges on the manufactured goods as they are distributed to our customers. Mr. Brown drew attention to one other direction in which expenses might be cut down, namely in the charge for rates and taxes, but here he was in reality advocating something which would be of benefit to the next generation and not to ours; his claim that local loans should be repaid within a shorter interval of time than is now necessary would in fact place, perhaps rightly, a heavier burden on our shoulders. It must in this connection be remembered that much of the great increase in local indebtedness which has begun to alarm some of our statesmen, is due to the borrowing of money for remunerative undertakings, and that as long as the general prosperity of the nation lasts, such municipal undertakings as electric lighting works, waterworks, gasworks, tram-lines, &c., are not likely to become a burden to the community. The money sunk in them is in a similar condition to that invested in ordinary commercial undertakings; the rate-payer pays no increased rates in consequence of them, but in reality obtains many absolute necessities of modern life cheaper than he would were these undertakings in private hands.

The visit to Barry, mentioned above, was a most enjoyable and instructive one; the extraordinary change in the district since the Association met in Bath, when a similar visit was made, was a striking object-lesson in the growth of the Welsh coal trade. The new dock was actually opened at this visit, since the three launches in which the party were taken round were the first vessels to steam from the old dock through the connecting cut (the dam closing this was only partly removed) into the new dock. The splendid caisson for closing this cut, which was worked with the utmost ease and perfect truth, and the extensive equipment of cranes and appliances for shipping coal were the objects of much admiration on the part of the visitors. Mr. Davison's paper, well illustrated by lantern slides, in which all the difficulties met with in the construction (and so well overcome) were clearly described, had prepared the members of the Section for this visit, which also made Prof. Ryan's somewhat technical paper on the coal-tips in use in South Wales a much more valuable and interesting contribution.

Monday, as usual, was devoted to electrical engineering, when three papers on the application of the electric motor to the engineering workshop, by Mr. A. Siemens, Mr. H. H. Gibbings and Mr. W. Geipel, were read and jointly discussed. The best discussion in the Section at this meeting rose over these three papers, Prof. Silvanus Thompson arguing that in England, by adhering to the continuous current so rigidly, we were dropping behind continental and American engineers, who found no difficulty in their alternating current systems; he claimed that all the difficulties could be easily met and solved, if we only faced them and made use of the experiences of other workers in the field. This contention was hotly denied by Mr. Parker and other speakers, and in the end the matter was left where it began: but, at any rate, it gave an opportunity of publicly thrashing out once more this vexed question. The novel plan adopted at Bradford of hiring out motors to small customers, with the object of increasing the day load at the central station, and also of stimulating small industries will, perhaps, be widely adopted; but it is very questionable whether the charge made for loan of the motor is in any way sufficient to cover depreciation of these somewhat delicate machines. Mr. Proctor, electrical engineer to the city of Bristol, gave some valuable figures as to the comparative cost of working steam and electric pumps for boiler feeding, &c., in central stations; the economy of the electric pump was very distinctly shown, especially at light loads; the experiments have, however, hardly been of a sufficiently extensive character to justify absolute conclusions in all cases.

Prof. Silvanus Thompson and Mr. Walker contributed a joint paper on electric traction by surface contacts, in which most of the schemes so far brought forward were described; the experiments conducted by the authors on an experimental line at Willesden were explained, and many of the details described by the help of lantern slides. There was a very scanty discussion, turning chiefly on the possible danger of such studs giving electric shocks (the author explained in reply this was impossible), and on the question of the cost of fitting up such apparatus.

There were two papers descriptive of new instruments—one by Mr. Coker describing a very ingenious instrument for attachment to test bars under torsional stresses in order to measure the small strains or twists, while the material was still in the elastic stage. The instrument had been tried in the mechanical engineering laboratory at University College, London, and found to work well and with complete freedom from all back-lash; it is, however, too delicate and complex to place in the hands of students. The other paper was by Prof. Hele-Shaw on a new instrument for drawing envelopes, and its

application to the teeth of wheels and for other purposes. This communication and also Mr. Forster Brown's are to be printed *in extenso* in the *Proceedings* of the Association. The instrument was a very beautiful one, and the difficult problem it solved had been most carefully worked out; but here again a very poor discussion followed, because no one felt able to criticise the instrument or discuss the advantages or disadvantages of such a piece of apparatus after merely hearing the author's short account; a description with sufficient diagrams ought to have been weeks before in the hands of those anxious to become acquainted with it, and to discuss it.

Amongst other papers dealt with was Mr. Dibdin's paper on the treatment of sewage by bacteria, which in the discussion elicited from Sir Alex Binnie the statement that the experiments he was carrying out for the London County Council led him to believe we were on the eve of most important changes in the treatment of town sewage.

SCIENCE IN RELATION TO TRADE.

DURING the last few years numerous references have appeared in the various reports made to the Foreign Office by Her Majesty's diplomatic and consular officers on the methods adopted by the principal trade rivals of the United Kingdom in their competition in foreign trade abroad, and on the apparent supineness of British traders in meeting this competition. Besides calling attention to this, the Consuls suggest the adoption of certain measures which they consider would be advisable for British traders to take with a view of retaining the pre-eminence of this country on foreign markets.

A selection has been made of the views expressed in some of these reports issued during the period comprised between January 1896 and the present time, and has just been published in a Blue Book.

From the 171 extracts in this publication it appears that the following are some of the causes which are considered as tending to place British trade at a disadvantage in those districts where, especially of late years, foreign competition has been more than usually keen:—

I. The disinclination of British traders—

(*a*) To supply a cheaper class of goods.
(*b*) To be content with a small order at first.
(*c*) To study a customer's wishes.
(*d*) To adopt the metric system in calculations of weight, cost, &c.
(*e*) To grant credit facilities.

II. The scarcity of British commercial travellers, in comparison with those of other nationalities, their ignorance of the language of the countries they visit, and the endeavour to supply their place by a lavish distribution of catalogues and other matter printed in English only.

III. The inferiority of the British to the German and American methods of packing.

IV. The additional cost of goods caused by the high rates of freight on British lines of steamers.

V. The frequency of strikes in the United Kingdom tending to cause uncertainty in the delivery of orders.

VI. The development of technical education in Germany and the greater attention paid in schools to modern languages, added to the system of sending young Germans all over the world to acquire a practical knowledge of the language, business habits, &c., of other countries, by means of which they are afterwards able to compete with those countries with a greater chance of success.

The two causes which concern us refer to the use of the metric system and the development of technical education in Germany. On these matters the Blue Book contains the following summary of the views expressed in the reports:—

METRIC SYSTEM.

The Consuls all lay stress upon the uselessness and expense of British exporters forwarding trade circulars and catalogues more or less well-prepared in English, and with English weights and measures calculated in our own currency. British weights and measures are not liked abroad, and are in many cases either not understood at all, or very imperfectly so, and the preference is given to those who accommodate themselves to the metric and decimal systems. On this point the Consul at Naples expresses himself as follows:—"It seems absurd that the first commercial nation in the world should measure their horses by hands and their dogs by inches, their cloth by ells and their calico by yards; that such impossible numbers should come into their square measure as $30\frac{1}{4}$ and 4840, and in their measure of solidity as 1728. And the weights are worse still. It can never be too much impressed upon British traders that all goods for sale on the continent should be marked in metres and kilogs, and all catalogues sent to the continent should be in a language which is understood by the people of the country."

TECHNICAL EDUCATION.

Much has been written respecting the superiority of the German technical education to that of Great Britain, and to this has been attributed the success which is said to have attended German commercial enterprise within the last twenty-five years That the technical education is better than that in England is denied by many Germans who are competent to express an opinion, having studied the question in both lands; but what they do admit is that the application of this education in Germany is carried out to a more practical and useful conclusion than in England. "Thus," says the Consul at Stettin, "in Great Britain there are numerous public and private schools having a modern side in their curriculum which is an excellent adaptation of what is termed in Germany the "real gymnasium"; but in how many English schools is the modern side looked down upon by the head master and consequently by the boys themselves; and the classic side held up as the education which befits a gentleman! . . . Undoubtedly the far greater majority of British lads, on the completion of their education, become what is vaguely termed men of business, and at the present day it is an absolute necessity for the carrying on of that business against the keen competition which, owing to European peace, has manifested itself in foreign lands during the last twenty-five years, that we, as a nation of merchants, should be able to deal with our customers in their own tongues; and for this purpose it is of the utmost importance that the youth of Great Britain should be instructed for the most part in living languages."

Again, attention is called in the reports to the fact that Germans have been gradually paving their way to their present position by quiet individual persistence backed up by special education. It is stated that they are in the habit of going as clerks into British houses at home and abroad and gradually obtaining a thorough knowledge of the British way of doing business, of the centres of production, &c., which they subsequently turn to good account; but some doubts are expressed as to whether any German houses would receive an Englishman in the same way even if he possessed the necessary qualifications. On this point the British Vice-Consul at Porto Alegre says: "Germans can generally speak English and French practically and usefully, and were taken into English houses at first because they were content with little, and sometimes even no salary, in order to pick up business. On the other hand, the English clerk usually understands no language but his own, and this deficiency alone would be enough to prevent his being taken on as a clerk in a German house. Twenty or thirty years ago the important export trade of this State was almost exclusively in the hands of British merchants; now it is in German hands."

THE DEVELOPMENT OF THE TUATARA LIZARD.

PROF. A. DENDY, professor of biology in Canterbury College, New Zealand, has been engaged for the past two years in investigating the development of the Tuatara Lizard, perhaps the most remarkable animal now living in New Zealand, and the oldest existing type of reptile. A short summary of the principal scientific results obtained was sent to London just in time to be laid before the Royal Society at its final meeting for the session in June last. The memoir itself, containing a detailed account of the general development, with numerous illustrations, has now arrived in England, and will shortly be published. Meanwhile, the following particulars, published in the *Christchurch Press*, will be of interest to naturalists:—The development of the Tuatara presents several remarkable features. The eggs are laid in November, and on Stephen's Island take about thirteen months to hatch, the embryos passing the winter in a state of hybernation, unknown in any other vertebrate embryos. Before entering upon their winter sleep the nostrils of the embryo

become completely plugged up by a growth of cellular tissue. The embryos obtained have been classified in sixteen stages. The early stages of development are singularly like the corresponding stages in the Chelonia, especially as regards the fœtal membranes; there being a long canal behind the embryo leading to the exterior, and known as the posterior amniotic canal, which has hitherto been found only in Chelonians, in which it was discovered a few years ago by Prof. Mitsukuri, of Tokyo. Prof. Dendy's results thus strongly confirm the views of those naturalists who regard the Tuatara as being at least as closely related to the turtles as it is to the lizards. In the later stages of the development the young animal has a strongly developed pattern of longitudinal and transverse stripes, which disappear before hatching, the adult animal being usually spotted. This observation is a striking confirmation of the general laws of coloration observed in young birds and mammals, which are commonly striped. The eggs which Prof. Dendy investigated were collected for him by Mr. P. Henaghan, principal keeper on Stephen's Island, who showed indefatigable zeal in the pursuit, and made many valuable observations on the habits of the Tuatara. Permission was granted to Prof. Dendy by the Government to collect both eggs and specimens for scientific investigation, and the result of Mr. Henaghan's observations has been to show that eggs can be obtained all the year round by those who know where to look for them. Fortunately for the Tuatara Mr. Henaghan appears to be the only collector who does know at present, and it is to be hoped that before his knowledge is made public the Government will take steps to prohibit the taking of eggs as well as of adults, for we believe the wording of the Act leaves the eggs unprotected. We believe that two German collectors have lately made vigorous, but as yet unsuccessful, efforts to collect the eggs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. E. W. Barnes, bracketed Second Wrangler 1896, Class I., first division Mathematical Tripos, Part II, 1897, has been elected to a fellowship at Trinity College.

Prof. Liveing has been appointed a University Governor of the South-eastern Agricultural College, Wye, for five years.

Prof. Flinders Petrie has presented to the Museum of Anatomy and Anthropology nineteen cases of skulls and bones from his excavations at Hierakonopolis, including remains of the prehistoric and earliest dynastic races in Egypt. Prof. Macalister remarks that with this addition the University collections in Egyptian anthropology are probably the largest in Europe; it consists of specimens representing all periods of Egyptian history from prehistoric times down to the battle of Tel-el-Kebir.

Prof. Foster will this term give a weekly lecture on the history of Physiology. The first lecture, on Monday, October 24, will be on Claude Bernard.

The Reader in Geography, Mr. Yule Oldham, lectures this term on the geography of Europe and on physical geography.

The University of Sydney is to become affiliated to the University of Cambridge, and students in arts or in science who have pursued a certain course at Sydney will be entitled to the privileges of affiliated students.

MR. JOHN CORBETT, formerly M.P. for Mid-Worcestershire, has offered to give 50,000*l.* for founding and endowing a school of agriculture for sons of tenant farmers for the county of Worcester and district.

ONE of the most recent of the many educational conferences held in the United States during the past ten years, was that of a Committee on Physical Geography appointed under the National Educational Association. As is usual in such cases, the members of the Committee were selected from a wide range of educational institutions, including universities, colleges, endowed schools, and public schools (in the American sense of the term); the expert in the scientific aspects of the subject being thus associated with the practised teacher, who is familiar with the capacities and limitations of young scholars. The preliminary report of the Committee is published in the *Journal of School Geography* for September. It is strongly urged that the physical environment of man should constitute the leading theme of the subject, and that irrelevant items from astronomy, principles of physics, topics from historical geology, and the classification of animals and plants should be carefully excluded, in order to give time for the proper development of physical geography itself.

THREE members of a series, to be known as the Harvard geographical models, constructed by Mr. G. C. Curtis from designs by Prof. W. M. Davis, have been reproduced in a durable composition by Messrs. Ginn and Co., educational publishers, Boston, Mass., as aids in systematic geographical teaching. The models, 25 by 19 inches in size, may be used in elementary classes in illustration of type forms, such as mountains, peaks, ridges, glaciers, valleys, plains, volcanoes, capes, islands, rivers, lakes, deltas, bays, &c. They also serve for more advanced instruction in rational or explanatory physical geography. The second model is derived from the first by elevation, whereby a low and flat coastal plain is added to the mountainous background. The third is derived from the first by depression, whereby the valleys among the mountains are transformed into bays, and the ridges stand forth as promontories, the coast-line being changed from a simple to a very irregular outline. Many applications of the principles thus taught may be made in all grades of geographical teaching.

THE annual meeting of the governors of University College, Liverpool, was held on Saturday last. The Earl of Derby, president of the college, occupied the chair, and, in moving the adoption of Principal Glazebrook's report, which was of a very satisfactory character, he said that though much had been done, much yet remained to be accomplished. A pressing need was a proper building for the department of physics, and another very pressing need was a suitable building for the school of human anatomy. Prof. Oliver Lodge deserved to be furnished with adequate means for the important work in which he was engaged. That, however, might be postponed so that the more pressing equipment of a building for the school of human anatomy might be provided. The cost would be about 20,000*l.*, and he would contribute a quarter of this sum if other benefactors were forthcoming. It was announced by the treasurer that besides the 5000*l.* from Lord Derby, he had that day received a cheque for 2000*l.* from Mr. Ralph Brocklebank, for the school of anatomy. Incidentally it was mentioned that the land, buildings, and endowments of University College represented a total value of 400,000*l.*, though the college was founded only in October 1880.

COPIES of the prospectuses of the Day and Evening Classes held at the South-Western Polytechnic have been received. This Polytechnic has been built and equipped at a cost of nearly 55,000*l.*, the greater part of which has been raised by voluntary subscriptions. The institute at present possesses a fixed endowment of 1500*l.* annually from the Charity Commissioners. The London County Council will also contribute to the institute an annual sum, depending upon the amount of educational work carried on; and it is anticipated that this contribution will average about 3500*l.* annually. The Principal is Prof. Herbert Tomlinson, F.R.S., and from the prospectuses referred to we see that the operations of the institute are of a kind which will benefit industry and encourage scientific study. The Day College comprises two departments, viz. the technical department, in which students are instructed in the principles of applied science, and the general department, which aims at giving a general education, or special training in science, art, literature, or commerce. The evening classes and lectures are designed to supplement, and not to supersede, the training of the workshop. Among the subjects taught in the mathematical classes we notice the calculus and its application to electrical and other engineering problems. The subjects taught at the Polytechnic cover a wide range, as they also do in other London polytechnics; and they provide all who wish to learn with facilities for doing so.

THE trustees of the late Sir Edwin Chadwick have founded in memory of the great sanitarian a course of lectures and demonstrations in municipal hygiene at University College, London, and have devoted a sum of 700*l.* a year to the endowment of a chair of municipal engineering and a lectureship of municipal hygiene. They have given the further sum of 1000*l.* for the purpose of instruments and appliances, and for the amplification of existing laboratories. The *British Medical Journal* reports that, on Wednesday, October 12, Prof. Osbert Chadwick, son of Sir Edwin Chadwick, delivered an inaugural address opening the first course. After giving a sketch of the history of the

foundation, he observed that relatively little practical instruction can be obtained from lectures alone, and that their utility is greatly increased by a course of practical work. The drawing office is an essential adjunct to academic instruction; engineering is a high art, the art of applying the great sources of power in nature to the use of man, and it is only to be acquired by experience, practice, and observation. The course to be given in municipal engineering will comprise lectures by Mr. R. Middleton, on water works, sewage works, and the like. The lectures on municipal hygiene will give elementary instruction as to the cause of disease, methods of disinfection and bacteriology, and other matters which strictly belong to medicine, but as to which the engineer ought to have information in order that he may be able to design municipal works with intelligence. The Chadwick Laboratory will afford opportunities to the students for practical work in the analysis of air, gas, water, and in other branches of practical chemistry. The trustees have also founded a Chadwick Scholarship, under which the sum of 100*l.* will be paid as an honorarium to a practising engineer taking the student as pupil, or as an alternative the sum will be paid to the student to augment the small salary he may receive as an improver.

A PLEA for increased instruction in geology is put forward by Prof. Logan Lobley in the volume of *Transactions* of the South-Eastern Union of Scientific Societies for 1898. He points out that an elementary knowledge of geology could be given in our secondary schools in part of the time usually allotted for geography, a subject over which much time is worse than wasted in burdening the youthful memory with names and statistics that really mean nothing to the average pupil. At present the place of geology in the early education of the people of this country, whether it be that of the school, the technical college, or the university, is an insignificant one, and unworthy of the general educational importance of the subject. As a remedy, Prof. Lobley proposes that geology should be made an obligatory subject for university pass degrees. He remarks: The great cause of the general absence of scientific teaching in England is the example set by our two ancient Universities in not requiring some knowledge of what are called the natural sciences for the ordinary pass degree. A graduate of either of these two world-renowned seats of learning may leave his Alma Mater, and with honours, and yet be without even an elementary acquaintance with any of these sciences. The consequence is that the great public schools omit science from their obligatory curriculum, and devote their attention to those subjects which are alone required to fit their pupils for obtaining, when at the universities, the pass degree. The practice and the curricula of the public schools again are followed by less important schools, and by the preparatory schools, and the standard of education so set up and made fashionable dominates the teaching of schools generally. Hence it is, in a great measure, that in England education in science is so far behind that of Germany, and we look in vain for geology in the curriculum of an ordinary middle-class school—Prof. Lobley is justified in pleading for increased attention to be paid to geology, but considering that in this country the elementary principles of the subject included under physical geography, which should form the basis of all geographical teaching, are almost entirely neglected in the average middle-class school, there seems little hope at present that geology will find a place in the school curriculum.

ON Friday last Mr. Long, M.P., President of the Board of Agriculture, performed the ceremony of opening the experimental farm of Lledwigan, Anglesey, which is rented and managed by the Agricultural Department of the University College of North Wales, Bangor. This college was the first in the kingdom to apply for and to make use of the grant voted by Parliament for the promotion of agricultural education. The area of the farm taken is 358 acres, and the farm is considered one of the best in the county. The aim of the Agricultural Department is to illustrate experimentally the theoretical teaching given at the college. The farm will, therefore, be used as a practising school for the in-college students, as a permanent experimental station where experiments extending for a series of years can be made, and also as a dairy school for the counties of Anglesey and Carnarvonshire. The Professor of Agriculture at the Bangor University College will reside at the farm as the head and manager. He will be assisted by a small committee of practical farmers, who will be entrusted with the equipping, stocking, and cropping of the farm, and with the control of the finances. The Board of Agriculture make a special grant of 200*l.* towards the maintenance of the farm as an experimental and educational centre. A capital sum of 4000*l.* was required for the stocking of the farm. The Drapers' Company have generously made a conditional grant of 1000*l.*, and the college hope to secure the remainder in due time. In formally opening the experimental farm Mr. Long remarked that for a long time practical agriculturists had looked with suspicious apprehension, even with something akin to contempt, upon scientific method and procedure, but that feeling had to a large extent disappeared, and farmers began to realise that, after all, science meant nothing more than accurate knowledge of the causes which produced certain results, and that such knowledge could not fail to be of use to those who had to produce the results as a means of earning their living. In 1888, excepting three agricultural colleges, certain scattered science and art classes, and two local schools in Cumberland and Cheshire, nothing was done for agricultural education. In 1889 Parliament gave a grant of 1630*l.*, and of that Bangor College received 200*l.* In 1889 the grant was increased to 2610*l.*, out of which Bangor received 400*l.* In 1890 Parliament voted 750,000*l.* to the County Councils to be spent on technical education. The Board of Agriculture thereupon took a new departure and applied the Parliamentary grant to general as distinguished from local projects. The amount of the grant has been increased from 2610*l.* to 6800*l.*, and of this sum 5900*l.* is paid to collegiate centres.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 5.—Mr. R. Trimen, F.R.S., President, in the chair.—The President announced that the late Mrs. Stainton had bequeathed to the Society such entomological works from her husband's library as were not already in its possession. This bequest was of great importance, and would add to the library a large number of works, many of which, formerly in the library of J. F. Stephens, were old and now scarce.—Mr. J. J. Walker exibited a black form of *Clytus mysticus*, L. (var. *hieroglyphicus*), taken by Mr. Newstead at Chester, where about 1 per cent. of the specimens were of that variety; also a black variety of *Leiopus nebulosus*, L., from the New Forest.—Mr. Tutt exhibited an example of *Euchloe cardamines*, irregularly suffused with black markings, and a series of local varieties of Lepidoptera from Wigtonshire.—Mr. S. Image exhibited a specimen of *Acidalia herbariata*, taken in Southampton Row.—Prof. Poulton showed and made remarks on specimens of *Precis octavia-natalensis* and *Precis sesamus*. These strikingly dissimilar insects had been shown by Mr. G. A. K. Marshall to be seasonal forms of the same species; from two eggs laid by a female of the first-mentioned (summer) form he had bred one imago resembling the parent, and one which was of the blue *sesamus* form.—On behalf of Dr. Knaggs, Mr. South exhibited a series of *Dicrorhampha*, the synonymy of which was discussed by him and Mr. Barrett, *D. flavidorsana*, Knaggs, being shown to be a good species.—Mr. Barrett exhibited and made remarks on specimens of *Lozopera beatricella*, Wals., from Folkestone, and the allied species.—Mr. Porritt showed examples of *Arctia lubricipeda*, obtained by continued selection of the parents, and probably the darkest ever bred in this country.—Mr. Adkin exhibited a long series of *Tæniocampa gothica*, to show the results of breeding by continued selection, and some remarkable forms of *Abraxas grossulariata* from Pitcaple.—Mr. F. Merrifield read a paper, illustrated by a large number of specimens, on the colouring of pupæ of *P. machaon* and *P. napi* caused by exposing the pupæ to coloured surroundings. The pupæ of both species were found to be modified by the surroundings of the larva, the effect being extremely marked in the case of *P. napi*. When the larvæ of the latter species were kept in a cage half orange-coloured and half black, all but four of the pupæ on the roof of the orange-coloured side were green with very little dark spotting, and all the pupæ on the roof of the black side were bone-coloured with numerous dark-brown spots. He regarded the phenomenon as protective. The exhibit was discussed by Prof. Poulton, who showed a similar series of specimens, and observed that he found the rays near the D line of the spectrum had the greatest influence upon the incipient pupæ, the effect diminishing towards either the red or the violet ends. The effect, therefore, appeared to be one of luminosity. Mr. Bateson

stated that his own experience fully confirmed Mr. Merrifield's results, but was unable to see how the green coloration of the pupæ could be protective, at least in the winter brood. Mr. G. H. Verrall read a paper on Syrphidæ collected by Colonel Yerbury at Aden, the specimens, together with some rare British diptera, being exhibited by Colonel Yerbury. Papers were communicated by Mr. G. C. Champion on the Clavicorn Coleoptera of St. Vincent, Grenada, and the Grenadines; and by the Rev. T. A. Marshall on the British Braconidæ, Part viii.

PARIS.

Academy of Sciences, October 10.—M. van Tieghem in the chair.—Observations on the supposed transformation of fat into glycogen, by M. Berthelot. Comments upon the paper on this subject of M. Bouchard. The fact of the fixation of oxygen is undoubted, but the author regards the interpretation given to the facts observed as doubtful. It is probable that albuminoids may play a part in this temporary increase of weight. For a man to gain 40 grams of oxygen in an hour, means that nearly all the oxygen respired during that time must remain in the body. The respiratory coefficient under these conditions should be considerably reduced, and further experiments in this direction are very desirable.—Preparation and properties of calcium nitride, by M. Henri Moissan. Starting with pure crystallised calcium, prepared in the manner previously described, it is easy to prepare calcium nitride by the direct combination of the two elements. In the cold, nitrogen has no action upon calcium, but on gently heating a slow absorption takes place; the white metal becoming a bronze-yellow colour, the yellow colour attributed to calcium by previous workers being undoubtedly due to the presence of this nitride. At a low red heat the calcium catches fire and burns in the nitrogen, the absorption of the gas being very rapid. The reaction is best carried out in a nickel tube. At the temperature of the electric furnace the nitride is completely decomposed by carbon, calcium carbide remaining in the tube. Water decomposes it with violence, ammonia and calcium hydrate being formed. The suggestion is made that this substance may find a commercial application in the formation of ammonia from atmospheric nitrogen. On the results of Russian geodesic work in Manchuria, by M. Venukoff.—Remarks on the 50th volume of the "Mémoires de la Section topographique de l'État-Major général de Russie."—Observations of Perseid meteors made at Athens, by M. D. Eginitis.—On the integration of the problem of three bodies, limited to the first power of the disturbing mass, by MM. J. Perchot and W. Ebert.—On the energy of a magnetic field, by M. H. Pellat. It has been shown in a previous paper that the expression for the energy of an electrified system undergoes certain modifications if the quantity of heat is taken into account, that the medium gives to or takes from the exterior necessary to maintain its temperature constant during the change. In the present paper a similar expression is developed for the case of a magnetic field.—On a new iodide of tungsten, by M. Ed. Defacqz. By the reaction between aqueous hydrogen iodide and tungsten hexachloride a tungsten tetraiodide is produced, WI_4. The iodide is infusible, cannot be volatilised without decomposition, and is slowly altered by exposure to the air.—On a crystallised tungsten dioxide, and on a tungsto-lithium tungstate, by M. L. A. Hallopeau. By heating lithium paratungstate with hydrogen at a temperature near the fusing point of hard glass, crystallised tungsten dioxide WO_2 is formed.—Thermal study of the sub-oxide and dioxide of sodium, by M. de Forcrand.—On the combinations of lithium chloride with methylamine, by M. J. Bonnefoi. Pure anhydrous lithium chloride rapidly absorbs methylamine, and a study of the heats of formation and dissociation pressures shows that three distinct compounds are formed, $LiCl,CH_3.NH_2$; $LiCl,2CH_3NH_2$; and $LiCl.3CH_3NH_2$. The application of Clapyron's formula to the calculation of the heats of dissociation gives results closely agreeing with the experimental determinations.—On a diodo-quinoline, by M. C. Istrati. The introduction of the iodine is affected in the warm, in the presence of sulphuric acid. The iodo-quinoline isolated had the composition $C_9NH_5I_2$.—On phenyl-phosphoric and phenylene phosphoric acids, by M. P. Genvresse. These are obtained by the action of phosphorus pentoxide upon phenols.—The volumetric estimation of acetaldehyde, by M. X. Rocques. Rieter's method of titrating with alcoholic sulphurous acid is modified in such a manner as to increase the accuracy when strong solutions of aldehyde are under examination.—Thermal data relating to isoamylmaloric acid. Comparison with its isomer, suberic acid, by M. G. Massol.—Embryos without a maternal nucleous, by M. Yves Delage.—Air and water as factors in the food of certain Batrachians, by M. S. Jourdain. Under certain conditions the eggs of some frogs, during the period of embryonic development, borrow the constituent elements of the young animal from the stock of food materials which it contains, and from the air and water vapour of the surrounding medium.—On the composition and alimentary value of haricots, by M. Balland.—Remarks on an *aurora borealis*, observed at Guingamp, September 9, by M. V. Desjardins.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—La Fonderie: Prof. Le Verrier (Paris, Gauthier-Villars).—Notes on Water Supply: J. T. Rodda (King).—The Structure and Classification of Birds: F. E. Beddard (Longmans).—A Text-Book of Mineralogy: Prof. E. S. Dana, new edition (Chapman).—The Tides and Kindred Phenomena in the Solar System: Prof. G. H. Darwin (Murray).—The Story of Marco Polo (Murray).—Kepler's Traum vom Mond: L. Günther (Leipzig, Teubner).—The Story of the Farm: J. Long (*Rural World* Publishing Company).—Indiana, Department of Geology and Natural Resources: Twenty-second Annual Report (Indianapolis).—Les Ballons-Sondes et les Ascensions Internationales: W. de Fonvielle, deux édition (Paris, Gauthier-Villars).—Manual de l'Explorateur: E. Blim and M. Rollet de L'Isle (Paris, Gauthier-Villars).—How to Work Arithmetic: L. Norman (Rugby, Over).

PAMPHLETS.—Report and Transactions of the South-Eastern Union of Scientific Societies for 1898 (Taylor).—A Chemical Laboratory Course: A. F. Hogg (Darlington, Dodds).—Untersuchungen über die Theorie des Magnetismus, &c.: Prof. E. Dreher and Dr. K. F. Jordan (Berlin, Springer).—The School Cookery Book: M. Harrison (Macmillan).

SERIALS.—American Journal of Science, October (New Haven).—American Naturalist, September (Ginn).—Notes from the Leyden Museum, April and July (Leiden, Brill).—Himmel und Erde, October (Berlin, Paetel).

CONTENTS.

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Notes
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Prof.
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611
612